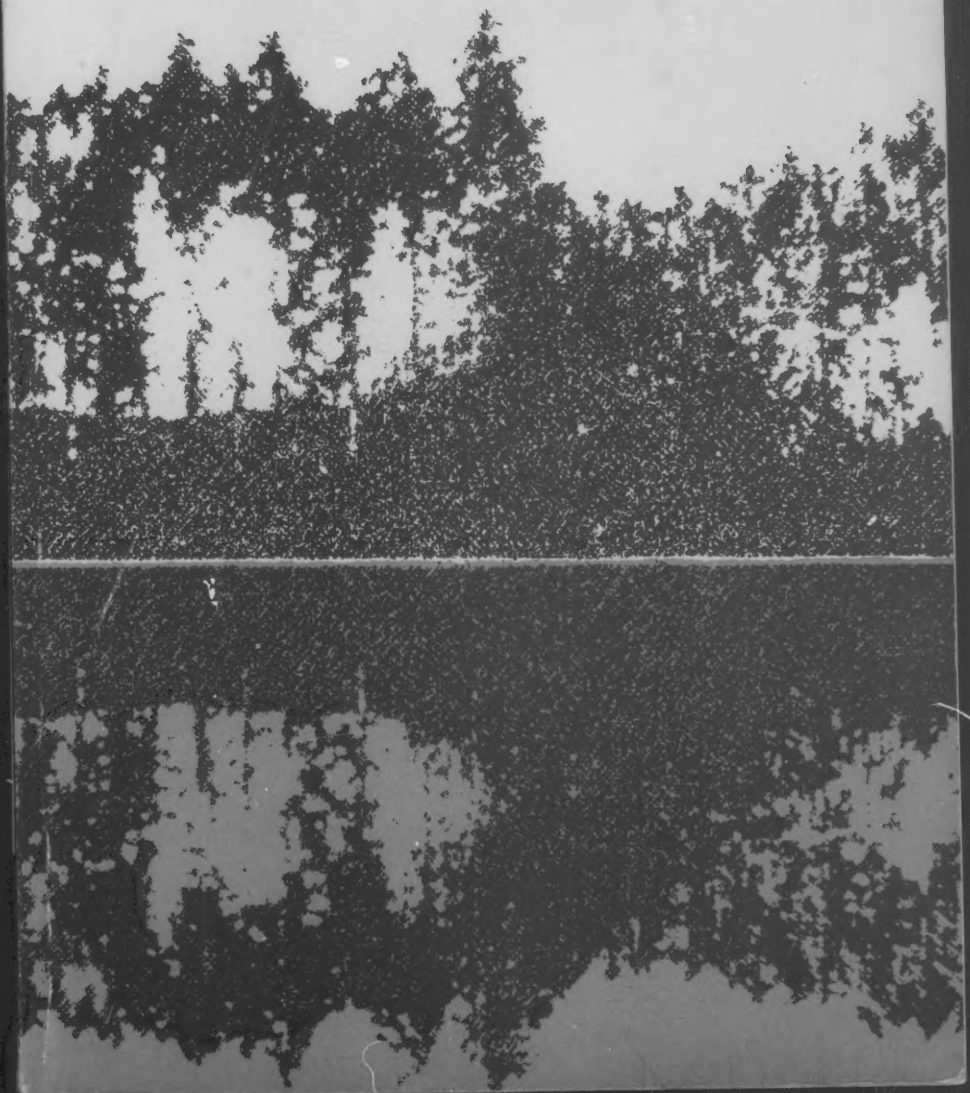
Environmental Quality

the ninth
annual report
of the council on
environmental
quality



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THE PRESIDENT'S MESSAGE

To the Congress of the United States:

I am pleased to transmit to the Congress the Ninth Annual Report of the Council on Environmental Quality.

The Report contains abundant evidence of progress in meeting our national commitment to protecting our environment. The dimensions of the task still before us also emerge from the Report. For example, the Report cites encouraging evidence that the quality of our streams and lakes is improving in many places. Yet few areas of the country are entirely free of even those water quality problems which we understand best and control most effectively. And we are only on the threshold of comprehending and controlling newer problems of toxic pollution in water supplies.

Our efforts to enhance the quality of urban environments offer another example. We have gained many insights in the past few years into how tax, water, sewer, transportation, and a host of other Federal programs affect the shape of cities and the use of land. Those insights are reflected in my Urban Policy Message of last March and in many new laws and Executive Branch policies. Yet as we find ourselves better able to cope with the problems of urban sprawl, new and unfamiliar problems have emerged with the unprecedented migration from cities to small towns and rural counties in the 1970's. The lesson is that even as we learn more and do better in protecting our environment, new challenges will continue to appear.

We can be proud of our achievements so far. In my 1977 Environmental Message, I promised energetic enforcement of the environmental programs already on the books and asked your collaboration in developing certain new ones.

As a result of our partnership, we can point to:

- The first law setting Federal standards for the stripmining of coal;
- a renewal of the Clean Air and Clean Water Acts, with strict but enforceable standards;
- amendment of the 25-year-old Outer Continental Shelf Lands Act to provide orderly development of offshore oil and gas resources with high standards of environmental protection;
- a nuclear non-proliferation law;
- our selection of the environmentally preferable route for shipping Alaskan natural gas to the lower 48 States;
- the permanent protection of nearly 95 million acres of unspoiled lands in Alaska in our park and refuge systems;
- a major expansion of the Nation's park and wilderness systems, including the addition of large acreage to Redwood National Park; and

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- effective regulation of fishing in the U.S. 200-mile fishery conservation zone, with a 50 percent reduction of foreign fishing and a total ban on commercial whaling within that zone.

Building on the foundation already laid by Congress and using authority already granted me, I asked agencies of the Executive Branch to undertake a number of broad policy reforms in environmental matters, including:

- a comprehensive new water resource policy that stresses conservation, environmental protection, Federal-State cooperation, cost sharing, and rational economic evaluation;
- an Administration policy that would reduce the risks of plutonium and nuclear weapons proliferation;
- vigorous support for the development of solar energy, continuation of selected solar projects, and a national policy review;
- improved protection of health and safety in the workplace, emphasizing serious health hazards while eliminating trivial regulations;
- a concerted drive by all Federal agencies to design a uniform approach toward the control of cancer-causing, life-altering toxic substances;
- a thoroughgoing reform by EPA of its regulations to minimize costs and delay, welcome outside ideas and participants, and test flexible new approaches, while ensuring adequate protection of health and the environment.

Finally, I directed the Council on Environmental Quality to issue regulations under the National Environmental Policy Act which will help all Federal agencies make well-informed, environmentally sound decisions, with a minimum of paperwork and delay. I asked for new regulations which would improve the government's ability to assess the effects of its actions and encourage the preparation of concise, analytic environmental impact statements. After public hearings and a thorough review by other Federal agencies, the Council drafted regulations to achieve these goals.

I am pleased that the United States has pioneered laws to protect our air, water and land. I believe our leadership has proved its worth. Since the National Environmental Protection Act (NEPA) was passed, at least 25 States have adopted "little NEPAs" patterned after the Federal model, 16 other nations have adopted some form of environmental impact review of governmental activities, and more than 80 nations have incorporated into their governments a ministry with environmental responsibility.

In the years ahead, let us continue our fruitful collaboration and our leadership in environmental protection.

JIMMY CARTER.

THE WHITE HOUSE.

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
722 JACKSON PLACE, N. W.
WASHINGTON, D. C. 20006

LETTER OF TRANSMITTAL

THE PRESIDENT:

Sir: The Council on Environmental Quality herewith submits its ninth Annual Environmental Quality Report in accordance with Section 201 of the National Environmental Policy Act of 1969 (42 U.S.C. 4341).

Respectfully,

Charles Warren
Chairman

Gus Speth
Member

Jane Yarn
Member

HIGHLIGHTS

CHAPTER 1 AIR QUALITY

- Clean air remains a principal goal on the nation's environmental program. Taking account of experience and progress so far, the Clean Air Act Amendments of 1977 set new deadlines for cleaning up polluted areas, added protection for clean air areas, and required review of existing air quality standards (one revision, for photochemical oxidants, was proposed in June 1978). (p. 1)
- Most urban areas have yet to achieve the existing standards for all five "criteria" pollutants. The overall trend in most areas is toward continued improvement. For photochemical oxidants and carbon monoxide—the most troublesome pollutants in U.S. cities—air quality improved significantly over the 4 years 1973–76 in most cities which have severe problems and for which data are available. (p. 1)
- Simultaneous violations of total suspended particulate and sulfur dioxide standards are rare, occurring only in a few lightly populated areas. Of the five criteria pollutants, only nitrogen dioxide showed no trend of improvement since the national ambient standards were set. When more stringent emission controls for autos take effect in 1981, improvements are expected. (p. 1)
- Enforcement efforts are focusing on major sources in a few large industries—chiefly electric utilities, iron and steel mills, and primary nonferrous smelters—which have disproportionately high rates of noncompliance. (p. 2)
- The existing national primary ambient standard for oxidants is 0.08 parts per million. . . . As a result of its reevaluation of health effects information, EPA proposed to revise the oxidant standard slightly, to 0.10 parts per million . . . . (p. 2)
- Because of the magnitude of the nonattainment problem, the proposed relaxation would do little to ease the need for controls on stationary sources of hydrocarbon emissions in the worst polluted cities . . . . Automobile emission standards would not be relaxed. (pp. 2–3)
- EPA has begun to reexamine the use of total suspended particulates as a measure of public health risk [and] is exploring the possibility of a standard based on particles small enough to be inhaled. (p. 3)
- EPA plans to revise the criteria for sulfur oxides in parallel with revisions of the particulate matter criteria. (p. 3)
- Pursuant to a court order . . . , EPA proposed a national ambient air quality standard for lead in December 1977. (p. 4)
- Setting an air quality standard is very difficult because lead in the air is not the only major source of exposure. EPA must estimate a contribution to blood lead levels from nonair sources. (p. 4)

- [O]f the nation's 60 most densely populated areas . . . , annual PSI statistics are presented for 43 cities. [Four], Los Angeles, Denver, Cleveland, and St. Louis, had index values above 100 (the "unhealthful" range or worse) at least one-half the year 1976. All the cities experienced unhealthy air quality for 27 or more days. (pp. 4–13)
- Automobiles are the principal source of [carbon monoxide]. In the 13 cities with complete data for 1973–76, the total number of days with harmful CO levels declined 36 percent . . . . (p. 14)
- The combined data show that the overall severity as well as frequency of CO violations have decreased markedly. (p. 14)
- CO levels in Manhattan, although still the worst in the United States, are improving. (p. 19)
- Combined data from 15 monitoring stations in 13 cities . . . show a 20 percent reduction in violations of the 0.08 parts per million oxidant standard from 1973 to 1976. Severe violations in which the level of oxidants exceeded 0.20 parts per million during the day declined 6 percent. (p. 19)
- For 2 years the Council on Environmental Quality has been developing methods for relating ambient air quality data, population statistics, and health impacts. (p. 33)
- Risk mapping for photochemical oxidants is more complicated than for CO. The health effects of oxidants are numerous, and they affect everyone although in different ways and degrees. Further, oxidant pollution . . . is far more widespread, putting large numbers of people at risk. (p. 48)
- [In seven cities analyzed by CEQ], exposure is greatest in frequency and magnitude away from the city center. The highest ozone exposures are in the suburbs, which are less densely populated than downtown areas. (p. 61)
- [Of] more than 200,000 existing stationary sources . . . subject to emissions limitations in State Implementation Plans[, a]pproximately 23,000 . . . are "major" sources [which] account for approximately 85 percent of all air pollution from existing stationary sources . . . . As of October 1977, 20,358 major stationary sources were in final compliance and another 1,276 were meeting incremental cleanup dates in compliance schedules or orders, representing a compliance level of 94 percent . . . . (pp. 71–72)
- Nearly two-thirds of all sulfur oxide emissions come from coal- and oil-fired powerplants. The plants are also responsible for heavy concentrations of particulates in the ambient air. Of the nation's 623 large coal- and oil-fired powerplants, approximately 74 percent operate in compliance with SO_2 emission limitations. (p. 72)
- The nation's 27 primary copper, lead, and zinc smelters account for approximately 10 percent of the total sulfur oxides emitted by stationary sources. . . . Eleven primary smelters are now operating in full compliance . . . . (p. 73)
- Fifty-three integrated iron and steel plants produce approximately 90 percent of all U.S. raw steel. These plants consist of 591 sources of air pollution . . . . Approximately 15 percent are operating in final compliance, and 26 percent are on schedules leading to compliance in the near future. (p. 74)
- As of November 1, 1977, 68 . . . of the 393 major federal facilities subject to the Clean Air Act were not in compliance with air quality standards or emission limitations . . . . Of the noncomplying facilities, 45 . . . were on an approved construction schedule; however, 24 . . . of the 45 were not expected to be in compliance by the July 1, 1979, statutory deadline. (p. 76)

- As of October 1977, 1,162 sources of air pollution were subject to the hazardous air pollutant standards regulating emissions of asbestos, beryllium, mercury, and vinyl chloride. Approximately 95 percent were in compliance with the standards. (p. 77)
- [D]uring the smelter strike of 1967–68, improved visibility throughout the Southwest was commensurate with the decrease in sulfur emissions. If the trend of increasing visibility impairment caused by increased power production in the Southwest is confirmed by more detailed monitoring, it will be necessary to control existing pollution sources (mainly smelters and powerplants) and to plan and control all industrial sources which may be introduced into the pristine parts of the western United States. (p. 79)

CHAPTER 2 WATER QUALITY

- Overall, national efforts of the past decade to improve water quality are beginning to show results. There is evidence of improvement in many specific places and in the trends data for a few pollutants and a few years so far. Continued improvement should be evident in the next several years . . . . But we are a very long way from our goals, and few areas of the country appear free of water quality problems. Pollution from nonpoint sources remains widespread, and control measures are still rudimentary. In addition, toxic pollutants in ground and surface waters appear to be a significant problem which we are just beginning to understand and control. (p. 90)
- In a recent summary of state reports to the Congress . . . , the Environmental Protection Agency indicated that 95 percent of the 246 hydrological drainage basins in the United States were affected by water pollution in 1977. (p. 91)
- The nation's most widespread water quality problems, as perceived by state officials, are high levels of nutrients, bacterial pollution, high concentrations of suspended sediment, and heavy loading of oxygen-demanding material and consequent oxygen depletion in streams. (p. 91)
- So far, uniform water quality data exist for only 3 years, so it is premature to characterize trends definitively. But it is encouraging that bacteria levels improved through the third year. (p. 96)
- According to state reports industrial discharges affect 72 percent of the basins in the country. . . . Oxygen depletion, excessive suspended material, oil and grease, heavy metals, and toxic chemicals are common industrial pollution problems. (p. 98)
- A classic illustration of the effects of heavy industry on water quality is the severe degradation of the Mahoning River as it passes through Warren and Youngstown, Ohio, both major steel centers. In this stretch of river there are large increases in lead, zinc, and phenols, all toxic pollutants at levels that can severely affect aquatic life . . . . As plants along the river begin treating waste water, improvement is expected. (p. 99)
- [Fifty-eight percent of] major municipal dischargers did not meet the July 1, 1977, secondary treatment deadline. (p. 110)
- In debates on the 1977 Clean Water Act, many Members of Congress expressed serious concern over the direction the grants program had taken—whether it had been used more to promote growth than to control pollution. (p. 110)
- These same concerns were expressed by top EPA officials . . . . In October 1977, EPA announced a major new policy emphasizing land treatment of municipal waste and released a manual to assist local planners

and consultants to make maximum use of land treatment alternatives. (p. 111)

- The Administration . . . supported amendments to place new emphasis on water conservation and recycling and on alternative treatment plants. The Congress largely adopted the Administration's recommendations . . . . [For example, under the 1977 Clean Water Act, after] fiscal year 1978, EPA may not make grants for treatment works unless the municipality demonstrates that innovative and alternative waste water treatment techniques have been fully studied and evaluated. (p. 111)
- Water quality is gradually improving as additional municipal and industrial treatment plants begin operating. . . . [O]f 11 cities where major treatment projects were completed between 1967 and 1975[, w]ater quality improved in eight municipalities and did not change in two. (p. 113)
- Compliance with requirements for treatment of point source discharges by federal facilities has been less than compliance by industry; 151 (66 percent) of the 228 major federal dischargers complied with the 1977 deadline, compared to approximately 84 percent of major industrial dischargers. The Administration's budget request for fiscal year 1979 included $484 million, which is expected to enable these federal sources to comply. In addition, the President issued an Executive order requiring that federal installations meet applicable federal, state, and local environmental requirements. (p. 115)
- During 1977, there was a 12 percent drop . . . from 1976 levels in ocean dumping of waste materials other than dredged spoils. Nearly 70 percent . . . of the total amount dumped was sewage sludge from the northeast coast. (p. 117)
- Nonpoint sources [of water pollution] are especially difficult to control. Indeed, they may stand in the way of achieving the 1983 goals in some areas. . . . [One hundred nine] areawide planning agencies established under Section 208 of the 1972 [Federal Water Pollution Control] Act identified urban storm water and agricultural and construction runoff as principal contributors to their water quality problems. (p. 118)
- Sediments fom nonpoint sources are estimated to be 360 times the quantities discharged from municipal and industrial point sources after treatment, and agriculture contributes over 50 percent of all sediment loadings. (p. 119)
- Biochemical oxygen demand (BOD) and nutrient loadings from nonpoint sources (feedlots, landfills, agriculture) are approximately 5 to 6 times loadings from municipal and industrial point sources. (p. 119)
- There are methods [to control urban runoff] that appear promising from the standpoint of cost—reducing sediment volume by running the water over lawns or other vegetated land, substituting vegetated drains for curb drainage, and storing water temporarily on parking lots, lawns, or other open spaces to reduce the peak runoff rate. (p. 128)
- Controls of pollution from rural nonpoint sources are varied. Improved cropping methods, restricting mine drainage, and controlling erosion in logging illustrate the management practices used. (p. 128)
- Comprehensive areawide planning and management under Section 208 of the 1972 Act is a primary vehicle for controlling nonpoint source pollution, rural and urban. . . . The [Section 208] program has been difficult to implement because of funding impoundments, lack of data on nonpoint source pollution, and the slow development of economical control techniques. The dominant problem appears to be an institutional one, however. (pp. 129–30)
- Contamination of water by heavy metals, pesticides, PCBs, and other organic chemicals has attracted national attention only in recent years.

These toxic pollutants can harm aquatic or human life in extremely low concentrations, which are often difficult to detect. (p. 131)

- A recent EPA study of surface waters, generally near industrial areas, showed that human activity has introduced toxic pollutants at significant levels in the waters. (p. 131)
- In 1976 EPA began the National Organics Monitoring Survey to determine the frequency of occurrence of specific contaminants in 113 drinking water supplies representing various sources and treatment processes. . . . The study demonstrated the presence of trihalomethanes (chloroform, bromoform, chlorodibromomethane, and dichlorobromomethane) in the water after treatment . . . . They are produced by chlorination during treatment of naturally occurring precursors, which are probably in humus but may also be in algae and other chemicals. (p. 139)
- Assessing the overall quality of ground water is much more difficult than evaluating surface water, and monitoring ground water receives only a fraction of the funds used for monitoring streams, lakes, and coastal waters. . . . A Federal Interagency Task Force on Environmental Data and Monitoring headed by CEQ is working on plans to improve the information base for evaluating ground water. (p. 141)
- Concern is growing that if the treatment plants which are eventually built [in smaller towns] use conventional approaches, municipalities may not be able to afford the operating costs. . . . For residents of communities with fewer than 10,000 people, projected annual costs approach $300 and sometimes more per household. The problem is made more acute by the fact that many small town homeowners have incomes well below the national median. . . . EPA Administrator Douglas Costle has suggested that annual homeowner costs in small towns should not exceed $66–130. (pp. 144–46)
- EPA surveys of [municipal waste water] treatment plants conducted in 1976 and 1977 reveal serious problems of operation and maintenance. (p. 146)
- A growing problem facing EPA and the states is to ensure that . . . major industries, as well as the increasing number of minor dischargers which install [water pollution] controls, operate and maintain them properly. (p. 149)
- In an analysis of the effects of point discharges and nonpoint sources, it is important to consider what the quality of water might be if all human influences were eliminated. The law itself sets as an ultimate goal achieving "chemical, physical, and biological integrity of the Nation's waters." If we could eliminate all human influences, how good would the waters be? Stated in another way, what goals can we hope to achieve? (p. 150)

CHAPTER 3 SOLID WASTES

- The Environmental Protection Agency estimates that . . . the rate of generation [of industrial wastes] is growing about 3 percent each year. (p. 159)
- Sludge from municipal waste water treatment is also increasing. (p. 159)
- Solid wastes from residential and commercial sources were estimated at 130 million metric tons in 1976, enough to fill the New Orleans Superdome from floor to ceiling twice a day, weekends and holidays included. (p. 159)
- In the past few years, numerous instances of degradation of surface and ground waters as a result of solid waste disposal have been documented. (p. 160)

- [I]mproper land disposal of municipal solid wastes has also led to fires and explosions at landfills and adjacent areas following the lateral migration of methane generated in the landfill and its concentration to dangerous levels, the breeding of disease vectors, and air pollution from open burning. (p. 161)
- Upgrading land disposal practices is an immense task. Roughly there are 20,000 general refuse sites, 23,000 sludge disposal sites, and more than 100,000 surface impoundments for industrial wastes. (p. 161)
- Finding sites for processing and disposal of the growing burden of wastes is increasingly difficult. (p. 161)
- For fiscal year 1978, federal grants totaling approximately $14.3 million were distributed to the states for their planning and development responsibilities under [the Resource Conservation and Recovery Act of 1976]—development of environmental controls for land disposal of solid wastes, regulation of hazardous wastes, and resource conservation and recovery activities. (p. 163)
- The most fundamental ways to lessen the environmental damage from waste disposal are to generate less waste and to recover and reuse valuable resources from wastes. Both approaches save energy and materials while reducing pollution. (p. 167)
- [O]ur municipal solid waste generation is high—about 1,300 pounds per person per year—and the rate of resource recovery is low—about 7 percent. (p. 167)
- Of the approximately 9 million tons of materials recovered annually from municipal solid wastes (90 percent is waste paper), most is recovered through source separation. (p. 170)
- A recent development is the establishment of information exchanges or clearinghouses on wastes available from industrial firms; the clearinghouses bring together waste owners and prospective buyers or users. (p. 172)
- Six states—Oregon, Vermont, Maine, Michigan, Connecticut, and Iowa—have laws requiring deposits on beer and carbonated soft drink containers. (p. 172)
- [T]he Federal Interagency Resource Conservation Committee established under RCRA . . . has a mandate to investigate, over a 2-year period, a variety of economic incentives and disincentives, taxes, subsidies, regulations, and other policies affecting resource conservation. (p. 172)

CHAPTER 4 TOXIC SUBSTANCES

- In November 1977, the registry of chemicals maintained by the American Chemical Society listed 4,039,907 distinct chemical compounds—and the registry includes only chemicals reported in the literature since 1965. The list has been growing at a rate of 6,000 per week. The number of chemicals currently in commercial production in the United States may be as high as 70,000 . . . . (p. 178)
- The environmental and health effects of most of these substances have not been adequately studied. (p. 178)
- The lack of a comprehensive system for storing and analyzing information makes it difficult to use the data that do exist. (p. 179)
- Benzene, which is implicated in causing leukemia, . . . is still found at hazardous levels in consumer products. A recent study found that typical exposure of a householder using benzene to strip furniture would exceed not only the current standard for occupational exposure but also the old

standard established before benzene's leukemogenic properties were taken into account. (p. 179)

- [T]he Hudson River is contaminated with a complex spectrum of toxic substances such as PCBs, benzene, xylene, cyclohexane, tetrahydrofuran, toluene, and chloroform, all of which pose a health threat to the 150,000 people upstate who drink River water. (p. 180)
- [T]he past year has seen encouraging developments . . . . [For example, i]n the 60-odd lead poisoning screening programs in the United States, the percentage of children found with unhealthy lead absorption showed a decrease, from 8.6 per 100 in 1976 to 7.4 in 1977. . . . Decreases in PCB levels in Lake Michigan coho salmon were reported for the first time since monitoring began 5 years ago. (p. 182)
- In his 1977 Environmental Message, President Carter gave high priority to prevention of toxic substances problems. He instructed CEQ to develop a coordinated interagency program . . . . CEQ formed the 17-agency Toxic Substances Strategy Committee comprised of members from federal agencies with major responsibilities for toxic chemicals. The Committee's work concerns not only the Toxic Substances Control Act but also other laws relating to toxic chemicals control, from early development through ultimate disposal . . . . (pp. 184–85)
- The extensive testing, recordkeeping, and reporting authorities of TSCA provide EPA with the necessary legal tools to develop the information base needed for rational control of chemicals technology. (p. 197)
- EPA has received some 120,000 reports covering up to 70,000 substances and plans to publish [an] inventory in January 1979. The next round of information that EPA will seek will focus on a portion of these chemicals and will include data on use and perhaps other factors such as byproducts and how long a chemical has been in production. (p. 201)
- [F]ew chemicals have been studied and characterized as to their environmental persistence and transport or long-term biological effects. TSCA authorizes EPA to require manufacturers to test their chemicals for these and other characteristics. Obviously, not all 70,000 chemicals in commerce can be adequately tested at once, and EPA is developing a priority scheme for selecting chemicals for testing. (p. 202)
- There are over 220 federal data systems containing data relevant to toxic substances assessment. Many of them are designed to meet only the particular needs of the parent agency and contain data that are duplicative, very highly specialized, or difficult to get for other purposes. (p. 205)
- Because environmental influences are so important in producing cancer . . . , a coordinated government strategy to prevent exposure to carcinogens is literally vital. (p. 209)
- To avoid the problems and inconsistencies that result from substance-by-substance rulemaking, some agencies are already developing for their own use general principles for identifying and regulating carcinogens. (p. 210)
- An automatic requirement which sets in motion a regulatory process for substances of concern to workers or consumers is an important step . . . [to] expedite the regulation of carcinogens. (p. 211)
- The past year saw unprecedented progress toward international cooperation among industrialized countries in control of toxic substances. . . . Recent laws for toxic substances control have been passed by the United States, Canada, France, Japan, Norway, Sweden, Switzerland, and the United Kingdom; other countries such as Australia and the Federal Republic of Germany are considering draft legislation. (pp. 211–12)
- [A]n ad hoc multinational conference held in Stockholm . . . reached general agreement on the need for greater international cooperation [on

toxic substances]. Six areas were selected for immediate attention . . . . (p. 213)

- The United States and Sweden were the first nations to announce regulations restricting certain nonessential aerosol uses [of fluorocarbons]. By mid-1978 regulatory action was under development by Canada and Norway; the Netherlands had proposed a labeling action, and a policy position by the European Communities was directed at a reduction in fluorocarbon use and/or production. (p. 215)
- Much of the international research is being carried on in conjunction with the United Nations Environment Programme World Plan of Action on the Ozone Layer, adopted in 1977. (p. 215)

CHAPTER 5 HUMAN SETTLEMENTS

- Since 1970 our fastest population growth has been in rural areas, not the cities. . . . [P]eople are moving out of our largest cities in substantial numbers. (p. 220)
- The nation's largest metropolitan areas experienced a net outmigration of about 2.2 million people from 1970 to 1976, in contrast with the net inmigration of 1.8 million in the 1960's. (pp. 220–21)
- There is increasing evidence that recent overall urban population figures may mask some important signs of reviving life in the central cities. In many older cities, significant rehabilitation efforts are taking place, and the affluent middle class which abandoned central city neighborhoods decades earlier is returning. (p. 222)
- Perhaps the most remarkable change in population trends from the 1960's is the turnaround in growth rates of nonmetropolitan areas. (p. 222)
- The most striking reversal in trends is in counties with the lowest population density—10 people or less per square mile and no towns with more than 2,500 inhabitants; it is here that the highest growth in migration rates is occurring. As recently as the 1960's, these same counties continually lost population by outmigration, mostly of younger people. (p. 222)
- "[L]eapfrog" or "buckshot" urbanization has created a variety of new environmental and land use problems. (p. 224)
- The change in regional growth rates is dramatic. From the 1940's through the 1960's the Northeast and North Central regions accounted for about 40 percent of the nation's population growth; in the 1970's, their share was only 14 percent. Most of the compensating increase is in the South, where populations that were stable or declining in earlier decades because of the rural exodus have now resumed growth. (p. 225)
- The two direct inducements to subregional growth appear to be energy production in the Rocky Mountains and Appalachia and the spread of retirement communities elsewhere. (p. 226)
- National and regional settlement patterns of the 1970's have caused or exacerbated a variety of urban environmental problems. The central cities have, in general, lost even more jobs than before, their fiscal resources have declined, their ability to provide services has diminished, and their physical deterioration has increased. (p. 226)
- It is generally agreed that the principal causes of urban decline are private, economic, and social forces such as technological change, regional disparities in business costs, and residential preferences. Nevertheless, federal, state, and local government policy has in many cases aggravated urban problems. State and local annexation policy, for example, has a

powerful, if unintended, effect. . . . [C]ities in the Northeast and Midwest have remained "landlocked," permanently separated from the growth in surrounding suburbs. (p. 228)

- Several major federal programs and policies have reinforced—often inadvertently—the trends that cause cities to decline. Examples are federal funding of water and sewer systems . . . , federal highway construction . . . , location of federal facilities . . . , procurement of federal goods and services . . . , and failure to target federal aid . . . . (p. 229)
- In proposing a National Urban Policy on March 27, 1978, President Carter emphasized a "new partnership" among all levels of government, the private sector, and neighborhood and voluntary organizations to make the cities better places in which to live and work. (p. 229)
- The basic persistent, broad structural problems of cities—unemployment, deteriorated physical conditions, and inadequate public services—were the target of major proposals in the urban program. (p. 229)
- [S]upport for special urban areas, notably neighborhood efforts to improve or maintain themselves, is also an essential element in comprehensive aid to cities. (p. 231)
- Rehabilitation of rundown houses and businesses—recycling the city physically and preserving the spirit of existing neighborhoods—received strong support . . . . (p. 232)
- Achievements of small-scale neighborhood programs have already been demonstrated in many places in the country. (p. 232)
- Reduction of urban sprawl and creation of more livable cities are two emerging and interrelated federal strategies which are reflected by the Urban Message. (p. 235)
- [Enhancing the urban] environment with amenities like open space, parks, and recreation is important to the quality of life for all urban dwellers. (p. 236)
- In many older cities, park and recreation systems have suffered from protracted disinvestment; some have less money for recreation now than they did 5 years ago. Operation and maintenance of existing facilities are particularly pressing problems . . . . (p. 237)
- [S]kyrocketing land costs and finite funding sources make it impossible to provide public needs for open space through acquisition alone. Other legal techniques can preserve open space while keeping properties on the public tax rolls, thus requiring expensive land purchases only where important recreation, ecological, or cultural values cannot otherwise be obtained. (p. 238)
- Overall, the Land and Water Conservation Fund has not provided close-to-home recreation for densely populated urban areas of the nation. Per capita, more than twice as much Fund assistance has gone to rural as to urban areas; further, within metropolitan areas, suburbs have received twice as much money as the core city areas . . . . (p. 241)
- The economic importance to the city of recreation is underscored in a study by the Rand Corporation, which . . . suggests that increasing the attractiveness of residential areas may be more alluring to new industry and commerce than simply reducing taxes. (p. 242)
- [T]he value of urban trees as effective air pollution sinks or filters received significant support from a recent EPA research report . . . . Central Park significantly dilutes sulphur dioxide in mid-New York City, and London's Hyde Park reduces smoke concentrations by over 25 percent. (p. 243)
- [M]ost of the outstanding living landscapes now vulnerable to leapfrogging urbanization simply cannot be protected *as a whole* by the usual

federal preservation and land acquisition policies. The areas are generally too large and federal funds far too limited . . . . Moreover, many landscapes thrive and depend on agriculture or recreation, and the area's character and amenities are linked with these economic activities . . . . (p. 247)

- [A "greenline park"] is . . . an area of outstanding importance [which] would be entirely delineated by a "greenline" and would be protected by an assembly of legal measures, of which acquisition would be just one relatively minor part. (p. 247)
- The concept is not new. Precedents include the Adirondack Park in New York state. (p. 248)
- [T]he Administration endorsed a new "greenline park" proposal for the protection of the Santa Monica mountains and its adjacent coasts. (p. 248)
- Protection of the nation's 100,000 miles of shoreline . . . is progressing as states complete their management programs under the Federal Coastal Zone Management Act. However, legal challenges by the oil industry are testing many fundamental aspects of this pioneering land use law. (p. 249)
- Five estuarine sanctuaries have so far been established under the joint federal-state program authorized by the [Coastal Zone Management Act] . . . . Among a score of other areas under consideration . . . are two, in Florida and California, for which state planning is well-advanced. (pp. 251–52)
- Two east coast ocean areas . . . off North Carolina and . . . Florida, are already established as [marine] sanctuaries. In mid-1978 there were proposals for six other areas, one in the Gulf of Mexico off Texas and five in waters off California . . . . (p. 252)
- New highway construction has declined, not because of less reliance on the automobile but because the Interstate Highway System is nearly complete. (p. 253)
- The Department of Transportation's environmental review process considers the impacts of specific transportation projects on human settlements and helps to ensure that highway and transit projects are compatible with the surrounding environment. (p. 254)
- Only in the last few years has transit use begun to recover slightly from a 30-year decline. Since 1974 it has edged upward, rising approximately 0.9 percent per year. (p. 256)
- New highway and transit legislation sent to the Congress by Secretary [Brock] Adams . . . embraces three major goals—to improve transportation planning, to make funding more flexible, and to complete essential gaps in the Interstate System. The Administration also proposed increases in surface transportation funding . . . . (p. 258)
- California . . . is considering major changes in urban transportation policy which would deemphasize new freeways and give a higher priority to maintenance of existing ones and to public transportation. (p. 260)
- The Federal Aviation Administration provides extensive guidance to airport operators and the public on ways to reduce noise and achieve compatible land uses around airports. (p. 261)
- [The FAA has agreed with CEQ to consider] nonconstruction alternatives such as flight rescheduling, variable landing fees and use of reliever airports . . . in airport EISs. (p. 262)

CHAPTER 6 NATURAL RESOURCES

- Prime farmlands have been the most efficient, energy-conserving, environmentally stable lands available for meeting food needs. Their importance increases as doubts arise that the great growth in productivity of U.S. farms over the past quarter century can be sustained. (p. 269)
- [T]he evidence is that the soils best able to produce . . . crops are being turned to other uses at disproportionate rates. . . . The national loss of prime farmland is currently estimated at about 1 million acres per year, a little over 4 square miles *per day*. (p. 270)
- Loss of farmland . . . has environmental effects beyond the loss of crop-producing capacity. All open lands . . . help maintain local water supplies . . . , protect the hydrologic integrity of watersheds . . . , and . . . protect aquifier recharge areas . . . . (p. 270)
- Federal, state, and local governments are becoming aware of how their actions may affect prime land and what they can do to protect it. Although federal activities themselves rarely directly use or convert large areas of prime land, federally funded projects and loan programs may exert powerful adverse secondary effects. (p. 272)
- State and local governments have a variety of options to explore in their efforts to preserve prime farmlands. . . . [T]ax assessment by itself is an expensive, frequently ineffective tool for preserving prime farmlands . . . . A variety of "less than fee" acquisition techniques [is being] used to protect agricultural resources. (pp. 272–73)
- Over the last 200 years, U.S. cropland has lost approximately one-third of its topsoil. Since 1935, about 100 million acres have been degraded to the point where they cannot be cultivated; on another 100 million acres, more than 50 percent of the topsoil has been lost. (p. 274)
- The dominant form of U.S. soil loss is sediment carried off by water. Some 4 billion tons of sediment per year are delivered to the waterways of the 48 contiguous states. (p. 274)
- [T]he inherent drawbacks of depending on chemical pesticides as the primary line of defense against pests are increasingly apparent. . . . Heavy use of chemicals has introduced problems of pesticide resistance, destruction of natural enemies, outbreaks of secondary pests, reductions of pollinators and other beneficial species, environmental contamination, and some human health hazards. (p. 277)
- Worldwide, in 1975, 305 species of insects, mites, and ticks were known to possess genetic strains resistant to one or more chemical pesticides; another 50 species were suspect. (p. 277)
- [In] California, . . . 75 percent of the state's most serious crop insect and mite pests have developed genetic resistance to at least one insecticide, and some are resistant to two or more insecticides. (p. 277)
- A promising alternative to the use of pesticides . . . is . . . integrated pest management. IPM uses all suitable techniques and information to reduce pest populations to tolerable levels, which adequately protect humans, domestic animals, and the environment. (pp. 278–79)
- Many recent reports agree that IPM holds great promise for cost-effective, environmentally sound pest control in agriculture, forestry, urban areas, and public health. (p. 279)
- [In a] University of Arkansas [IPM] project . . . for cotton . . . [, p]articipating farmers . . . reduced the number of insecticide applications from an average of 10 per year to 2 while maintaining the same yields. (pp. 279–80)

- The Administration's comprehensive water resources policy . . . places a new national emphasis on water conservation, gives increased attention to the environmental concerns related to water projects, improves the planning and evaluation of federal water programs, and enhances federal-state cooperation in water resources management. (p. 282)
- A severe water shortage exists now in 21 subregions, mainly in the Central Plains and southwestern states. A potentially severe shortage is anticipated in 18 regions by 2000, mainly in the Northern Plains states, Rockies, and northern California, if consumption grows as projected. (pp. 283–84)
- Initiatives in the President's Water Policy Message to encourage conservation include technical assistance, federal program reforms, and pricing. (p. 284)
- The environmental problems of water projects are much larger in scope than the occasional "endangered species" controversies. For example, flood control, navigation, and drainage projects have eliminated several million acres of productive agricultural and forest land and valuable wetlands and marshes. (p. 285)
- The Water Resources Council is to evaluate the benefit-cost calculation procedures now in use by agencies and develop a new planning manual . . . [which] should eliminate double counting and inclusion of benefits that are inconsistent with federal policy or sound economic rationale. (p. 286)
- Two important goals . . . are to involve the states more closely in water project decisions and to eliminate conflicting rules governing cost sharing for flood control projects, especially those for structural and nonstructural measures to reduce flood damage. (p. 287)
- Surface mining . . . for [noncoal materials] may also seriously disrupt the environment. (pp. 288–89)
- Both the mining and beneficiation . . . of phosphate . . . consume millions of gallons of water . . . . Surface mining of phosphates also releases radioactive radon gas to the atmosphere and radium to surface and ground water systems. . . . Other ecological . . . impacts . . . are common to surface mining of many materials: diversion of creeks and streams, destruction of all the vegetation on the mining site, removal and loss of topsoil, and adverse alteration of animal habitats. (p. 289)
- The Congress authorized CEQ to contract for a comprehensive study . . . to assist in the establishment of reasonable regulation of surface and open pit mining and reclamation for minerals other than coal. (p. 289)
- The century-old Mining Law [of 1872] does not allow adequate control of environmental damage caused by mineral development. Nor does it permit orderly planning for use of the public lands. (p. 291)
- [An Administration-]proposed . . . law would ensure protection during and after mining and would keep discretion over mining on the public lands in the hands of the owners' agent, the federal government. (p. 292)
- President Carter instructed the Department of the Interior, the Department of Agriculture, CEQ, and his economic advisors to prepare a report on "the best way to sustain expanded timber harvests from Federal, state and private land and other means of increasing lumber yield in ways that would be environmentally acceptable, economically efficient and consistent with sound budget policy." (p. 292)

- Because new plantations on private forest lands in the Northwest are not yet replacing the cuts of earlier years, the Forest Service and others project a decline in yields from these lands. (p. 293)
- Environmental groups have emphasized the costs of raising allowable cuts of the mature old trees on the public lands. (p. 293)
- Conservation policy also protects other highly prized forest values such as watershed, wildlife, wilderness, recreation, and scenic beauty. (p. 293)
- In April 1978 the Department of Agriculture announced a revised pesticide policy which included restrictions on the application of 2,4,5-T to National Forest lands. The extremely toxic chemical dioxin is a constituent of this herbicide. . . . The revised policy emphasizes . . . the use of integrated pest management methods, systems, and strategies with the least hazard to people, their possessions, wildlife, and the natural environment. (p. 295)
- Legislation to protect Alaska's vast wilderness has been called "the highest environmental priority" of the Carter Administration and "the most important conservation action of the century." (p. 295)
- [T]he Carter Administration's recommendations for managing the federal lands in Alaska . . . would add nearly 92 million acres to Alaska's protected public lands in 10 new National Parks, 9 new Wildlife Refuges, 33 Wild and Scenic Rivers, and additions to existing Systems' lands. (pp. 296–97)
- Secretary [of Interior Cecil] Andrus recommended about 50 million acres for immediate designation as wilderness. In addition, the Interior Department will complete its review of wilderness study areas of highest priority by 1981 and by 1985 should have finished its study of all other potential wilderness acreage . . . . (p. 297)
- The National Wilderness Preservation System . . . includes 16.5 million acres (less than 2 percent of all public lands) and has increased by about 7 million acres since passage of the Wilderness Act of 1964. (p. 299)
- The potential effects of [current] federal wilderness study efforts are enormous. The initial stage of the Forest Service Roadless Area Review and Evaluation has inventoried for consideration for wilderness 62 million acres more than the area identified in the first review in 1972. (p. 299)
- [T]he Bureau of Land Management [has begun] the 15-year process—mandated by the Congress in the Federal Land Policy and Management Act of 1976—which will result in recommendations to the Congress by 1991 on which areas will or will not be added to the Wilderness System from BLM lands. (p. 299)
- [T]he President signed the Redwood National Park Act in March 1978. It [adds 48,000 acres of adjacent redwood forest to the Park,] makes available federal aid to prevent local economic damage, and protects the Redwood Creek drainage . . . . (pp. 301–302)
- About 16 percent of the public range is still declining in condition, 65 percent is static or uncertain, and 19 percent is improving. Through new grazing regulations . . . , adjustments of livestock use levels, and improvements such as revegetation, BLM hopes to repair the damaged rangeland and reverse the trend of deterioration. (pp. 302–303)
- The use of off-road vehicles on public lands has grown dramatically over the last decade; the environmental damages that they can cause is increasingly evident. Damage by ORVs has been documented in every kind of ecosystem in the United States, from North Carolina beaches to San Francisco hills. (Snowmobile use on adequate snow cover is an exception.) ORV damage is especially evident in the California desert, where

use is heavy and the desert ecosystem is easily damaged and slow to recover. (pp. 303–304)

- Total ORVs in use in the United States now exceed 10 million. (p. 304)

CHAPTER 7 ECOLOGY AND LIVING RESOURCES

- Living resources—forests, fisheries, wildlife—are usually described as renewable. . . . A pattern of abuse—characteristic of most of our history—can relegate living resources to nonrenewable status. (p. 310)
- [T]he Great Lakes are a system so thoroughly perturbed by people that it is difficult to imagine their original fisheries ever again becoming a true renewable resource. Stability, even in the presently managed ecosystem, has not been achieved. (p. 315)
- The original [Great Lakes] ecosystem . . . can never be replaced. The managed ecosystem that has taken its place is artificial and must be continually controlled by removing lamprey and adding salmon, and the cost in dollars, energy, and human effort is high. In the absence of human intervention, the new system would rapidly degenerate. (p. 314)
- Overall, 70 to 90 percent of all original riparian habitat in the United States has been destroyed. Along the Colorado River, for example, less than 10 percent of the original riparian habitat remains, and only 5 percent remains in the lower Gila Valley. (p. 317)
- In the arid West, riparian wetlands are usually shrubby forest adjacent to waterways. In the East, they are generally floodplain and bottomland hardwood forests. No ecosystem is more essential to the survival of the nation's fish and wildlife. (p. 316)
- Some wetlands are totally unsuitable for conversion for agricultural use . . . . When natural vegetation and drainage patterns are lost, the soils quickly deteriorate, and the land eventually becomes a barren, unproductive waste—in effect a nonrenewable resource. (p. 318)
- Where the alteration of the wetland is not irreversible—where, for example, the hydrologic regime remains unaltered and plants could come back if allowed—restoration can perhaps be accomplished through natural succession. Even so, the costs may be significant and the time required long. (p. 318)
- Of 11.8 million [Mississippi] Delta acres in forest in the early 1930's, some 40 percent have been converted to soybean cultivation and other nontimber uses. (p. 320)
- Because the Big Thicket [in east Texas] is a truly unique area, its continued modification and loss attracted national attention. . . . [T]he Congress authorized the . . . 84,550-acre Big Thicket Preserve—which will amount to about 3 percent of the original Big Thicket. . . . Despite the protection . . . these tracts will . . . still be affected by activities in other parts of the original Big Thicket outside the National Preserve. (pp. 321–22)
- Disturbances to the native fauna of the United States since European settlement serve as a useful indicator of overall changes to the living landscape from sophisticated human activities, especially since the industrial age began. (p. 323)
- In Hawaii, for example, many of the native species have become extinct or are in danger of becoming so. . . . Loss of habitat from agricultural expansion was one important reason. But the species suffered seriously from competition with introduced exotic competitors from both hemispheres . . . and also diseases carried by introduced bird species. (p. 323)

- Much of the increase in the [introduced] starling and native blackbird population has taken place because of changes in agriculture and land use. . . . Although large roosts of blackbirds have occurred earlier in our history, their present magnitude is clearly a result of human activities. . . . Even if today's large flocks and roosts of blackbirds could be reduced through chemicals or other means, the original balanced avifauna of preindustrial North America can never be restored, so great has been the effect of human activities. (pp. 324–25)
- Extinction of species is the surest way to convert a renewable living resource into a nonrenewable resource. Fossil evidence indicates that in prehuman times mammal and bird species became extinct at the rate of three per century. Since the 16th century, the extinction rate has jumped to 150 species each century. (p. 328)
- There are many reasons for extreme caution in permitting the extermination of plant species. For example, wild plants may have a tremendous potential for medicinal uses and as future food sources. (p. 329)
- Equally important ecological values of these species are not so easily measured or understood. . . . For instance, dogwoods accumulate calcium that is used by other plants in the same forest, and red alders fix nitrogen which is then available in the soil to other plants. (p. 330)
- [More or less permanent] loss of a renewable resource could conceivably happen in Antarctica if quotas on krill are set without knowledge of its rate of growth and regeneration or without an understanding of its role in the ecosystem. (p. 331)
- Efforts to reduce the incidental killing of porpoises during commercial fishing for tuna have not caused any obvious sacrifice in the size of the tuna catch. (p. 335)
- The United States, at President Carter's direction, has now prohibited commercial whaling within the U.S. 200-mile fishery conservation zone, under authority of the Marine Mammal Protection Act of 1972. (pp. 337–38)
- Ecosystem approaches to management of living resources are beginning to be incorporated into a number of situations. . . . [T]he International Whaling Commission . . . is beginning to consider [such principles] in establishing harvest quotas. (pp. 339–40)

CHAPTER 8 ENERGY

- Total U.S. energy consumption, having dipped by 5 percent between 1973 and 1975, rebounded by 7.5 percent between 1975 and 1977. (p. 343)
- [A] committee chaired by Dr. David P. Rall . . . reported to the President that a "safe" doubling of coal use by 1985 would require "rigorous" adherence to five principles:

  Compliance with all air, water, and solid waste regulations
  Universal adoption and successful operation of best available control technology on new facilities
  Compliance with reclamation standards
  Compliance with mine health and safety standards
  Judicious siting of coal-fired facilities. (p. 344)
- Improvements in U.S. energy efficiency, although not inconsequential, are far short of what is needed to reduce our long-term dependence on imports—mainly oil. (p. 345)
- [T]he technical and economic feasibility of substantial improvements over and above the conservation measures already in place is well-established. (p. 345)

- Perhaps the clearest evidence of a genuine shift toward conservation is in industry. . . . Despite a 5.6 percent increase in production, energy use [in the industrial sector] declined by 0.1 percent from the 1976 level. (p. 347)
- The reasons for these substantial gains have not been completely identified, but they may well be industry's response to increased fuel prices and its concern over availability of some fuels. (p. 349)
- [T]he steady growth [in residential and commercial energy use] of more than a decade plateaued for the 3 years 1973–75 and resumed in 1976 only with revival of the economy. Aggregate levels of commercial and residential energy use reached successive new peaks in 1976 and 1977. (p. 349)
- The data strongly suggest that fuel use trends reflect both price changes and other economic factors. (p. 351)
- Federal programs may well have major impacts on energy use in buildings in the future. For example, the Department of Energy has set efficiency targets for appliances to be effective in 1980, and the Department of Housing and Urban Development is developing thermal standards for new buildings started after 1980. (pp. 354–55)
- For highway travel, it appears that economic factors were largely responsible for both the drop in [energy] demand in 1974–75 and the resurgence afterwards. (p. 358)
- In air [travel] . . . energy use . . . [in 1976] was at its lowest level since 1967. Government-sponsored energy conservation measures have clearly made a significant change. They include lowering cruising speeds and eliminating some flights to increase load factors . . . . (p. 358)
- [E]vidence of public interest [in solar energy] was the participation by millions of people worldwide in Sun Day, May 3, 1978. (p. 361)
- In his [Sun Day] speech the President referred to the recent CEQ report on solar energy, which concluded that the nation could meet as much as one-quarter of its energy demands from solar sources by the end of the century and perhaps as much as one-half by the year 2020. The President declared: "Progress toward these goals is a cornerstone of this nation's energy policy." (p. 361)
- To accelerate the federal solar effort further, the President directed the establishment of a Domestic Policy Review to begin work on development of a national solar strategy . . . . (p. 361)
- In August 1977, Secretary of Interior Cecil Andrus announced a comprehensive revised planning schedule for oil and gas lease sales on the outer continental shelf through 1981. The schedule average of five sales per year [allows] time for consultation with states and for adequate environmental study while providing an "aggressive" OCS exploration program. (p. 364)
- The first exploratory drilling in the Atlantic OCS began in March 1978 after the Supreme Court declined to review a Second Circuit Court decision which lifted an injunction against the lease sale. (p. 364)
- Many features of the amendments [to the Outer Continental Shelf Lands Act] requiring environmental studies and consultation with states were adopted by regulation in January 1978. (p. 365)
- The Coast Guard announced a schedule for putting new international tanker standards into effect by 1979 for new ships and 1981 through 1985 for existing ships. (p. 366)
- The international agreement was a compromise. Although it falls short in several respects of the President's program and the original U.S. pro-

posals to IMCO, its provisions are a long step forward from any current requirements. (p. 366)

- Several states have taken action to protect special values in the coastal environment from possible damage due to tanker operations. (p. 369)
- California is particularly concerned about air pollution from tankers as well as oil spills. (p. 370)
- [T]he Department of the Interior has established a comprehensive Federal Coal Management Review. The Department is putting together a new programmatic environmental impact statement for coal development on federal lands and is analyzing the impacts of alternative leasing levels and leasing systems. (pp. 370–71)
- Meanwhile, coal leasing on federal lands is circumscribed by court order. In September 1977 . . . an earlier EIS for the coal program [was held] inadequate because it failed to demonstrate the need for extensive new leasing and thus failed to analyze the alternative of no action. The . . . court noted that 26 billion tons of potentially recoverable coal on federal lands was already under lease. (p. 371)
- As part of the coal management review, the Department is scrutinizing the coal leases not now in production in order to evaluate prospects for their development in an environmentally acceptable manner. This evaluation was specifically requested in the President's 1977 Environmental Message. (p. 371)
- President Carter signed into law the Nuclear Non-Proliferation Act of 1978, describing it as "a major step toward fulfillment of an objective which the United States shares with other nations—a halt in the spread of nuclear weapons capability while preserving peaceful use of nuclear energy." (pp. 372–73)
- [T]he United States sponsored an organizing conference of the International Nuclear Fuel Cycle Evaluation. The INFCE, a U.S. initiative, is a 2-year technical and analytical study to find ways of making available the benefits of nuclear energy while minimizing the danger of the proliferation of nuclear weapons. (pp. 373–74)
- Intense effort is going into investigation of alternatives to [nuclear] systems that use plutonium. (p. 374)
- In May, President Carter announced that the United States will seek to negotiate with the USSR and Great Britain a ban on the testing of all nuclear explosives for at least 5 years. (p. 376)
- Congressional efforts to continue funding for . . . the Clinch River Breeder Reactor, which is designed to use and produce plutonium as fuel, continued despite strong Presidential opposition, including a veto of the Department of Energy authorization bill for fiscal year 1978. (p. 375)
- The Nuclear Regulatory Commission's proceeding on whether to allow reprocessing and widescale use of plutonium as fuel in light water nuclear reactors was halted in December 1977 . . . . (p. 376)
- Safe storage and disposal of commercial nuclear wastes have become a major national issue. (p. 377)
- Several . . . reports have raised new doubts about our ability to predict accurately the long-term stability of geological disposal sites. (p. 378)
- Several state legislatures have now passed laws which would either require state approval of federal waste facilities or prohibit them altogether . . . . (p. 378)
- In March 1978 President Carter established a federal interagency task force on nuclear waste management. Chaired by the Department of

Energy, the task force is to report to the President recommendations for comprehensive decisionmaking and implementation. (p. 378)

- Growth of the nuclear power industry continued to lag behind forecasts. Nonetheless, nuclear power accounted for nearly 12 percent of all electricity generated in the United States during 1977, with some areas of the Northeast and Midwest relying on nuclear generation for nearly one-third to one-half of their electrical needs. (p. 372)
- Controversy over construction of twin 1,150-megawatt nuclear units at Seabrook, New Hampshire, continued for the third year. (p. 381)
- The Supreme Court ruled on June 26, 1978, that the Price-Anderson Act is constitutional. . . . The Court held that the Act provides a "fair and reasonable substitute for the uncertain recovery of damages" from a private utility in the event of a nuclear accident. (pp. 381–83)
- A number of scientists have charged that present federal radiation standards to protect workers against excessive risks are inadequate and that permitted exposure levels should be reduced to 10 percent of the present values. Other scientists, both inside and outside the government, believe that no direct evidence has become available indicating that existing standards are inadequate. The outcome of the controversy has important implications for virtually every activity involving ionizing radiation—from medical examinations to generation of electric power from nuclear reactors. (pp. 383–84)
- The fact that 800,000 people are potentially exposed to ionizing radiation on the job indicates the importance of occupational exposure. The average annual dose to these workers is about twice the natural background dose (that is, about 200 millirems per year). Nearly 10 percent of exposed workers, some 79,000 people, are employed in plants that require Nuclear Regulatory Commission licenses—generally in powerplants . . . . The average occupational exposure received at nuclear powerplants has recently dropped and in 1975 was approximately eight times the average background exposure (about 800 millirems per year). (p. 385)
- At low levels of exposure to ionizing radiation, acute symptoms do not occur, and identification of biological effects becomes very difficult . . . . (p. 386)
- Well-known . . . researchers . . . studied workers at the Department of Energy's Hanford Nuclear Facility in the state of Washington; . . . the effects of low-level X-rays; and . . . the workers at the Portsmouth Naval Shipyard in New Hampshire. They claim that even at very low radiation dose rates, there is a significant increased risk of cancer that is greater than had previously been suspected. (p. 388)
- Better understanding of the effects of low level exposures will depend upon a combination of further basic biological research and carefully designed, long-term epidemiological studies. At the same time, there is little doubt that somatic and genetic risks from manmade radiation sources can and should be limited by reducing unnecessary exposures. (p. 389)
- The effects of microwaves and radiofrequency radiation are also in dispute, as are those of ionizing radiation. (p. 390)

CHAPTER 9 NEPA

- The Council's proposed regulations to implement the National Environmental Policy Act were published on June 9, 1978. Their purpose is to

provide all federal agencies with an efficient, uniform procedure for translating the law into practical action. The new regulations are intended . . . to reduce paperwork, to reduce delays, and at the same time to produce better decisions . . . . (p. 396)

- A principal theme of the NEPA regulations is that decisions will be improved if agencies concentrate on the important issues and trim away masses of background data that obscure the real choices. (p. 397)

- The regulations establish a new procedure called "scoping" to ensure that the important issues are selected for attention from the beginning. (p. 397)

- At the time of decision on an action, the agency must prepare a concise public record, stating what the decision is and how the EIS was considered and used. If the environmentally preferred alternative was not chosen, the record must state what other considerations of national policy led to the choice. (p. 397)

- An effective way to reduce needless paperwork is to cut down on the size of the EISs, keeping them concise and to the point. . . . The Council's draft regulations recommend that future EISs should not usually exceed 150 pages or, for complex proposals, 300 pages. (p. 398)

- Several major provisions of the regulations are expected to reduce delays . . . . Integrating the NEPA review early in the planning of actions means less delay at later stages. Making the NEPA review concurrent with other environmental reviews and consultations eliminates the duplication inherent in separate procedures. (p. 398)

- The Council's NEPA regulations . . . clarify how NEPA applies in situations which have been handled differently by different agencies in the past. The variation in agency practice was confusing. . . . The regulations, which are binding, establish a basic uniform approach and set down clearly what it is to be. (p. 399)

- In developing the draft regulations, CEQ was greatly assisted by the hundreds of people who responded to the call for suggestions on how to make the NEPA process work better. (p. 401)

- CEQ also met with every federal agency to discuss what should be in the regulations. . . . [W]e studied agency comments in detail and consulted numerous federal officials with special experience in implementing the Act. (p. 402)

- [I]ncluded in the regulations is virtually every major recommendation made by the Commission on Federal Paperwork and the General Accounting Office in their recent studies on the environmental impact statement process. (p. 402)

- The only Supreme Court opinion to address agency responsibilities under NEPA in the past year was *Vermont Yankee Nuclear Power Corp.* v. *Natural Resources Defense Council.* In two consolidated cases involving NEPA's application to the construction and licensing of nuclear powerplants, the Court upheld the Nuclear Regulatory Commission's informal rulemaking procedures for determining the environmental effects of fuel reprocessing. (p. 402)

- The substantive requirements of NEPA and the extent to which courts can require agencies to consider them are discussed in a significant new treatise, *Environmental Law,* . . . [which] points out that NEPA's Section 101 contains sufficiently clear substantive standards to permit meaningful judicial review. (p. 403)

- Two cases involving state "little NEPAs," patterned after the federal NEPA, demonstrate how the courts have been willing to uphold environ-

mentally protective decisions by agencies using the statute's substantive goals or provisions as authority. (p. 404)

- Several important NEPA opinions in the past year dealt with the development of energy resources. (p. 406)
- The courts also addressed NEPA's role in the legislative process. (p. 407)
- Federal actions challenged in the courts under NEPA still represent a small fraction of the many thousands of federal actions assessed for environmental impacts. As of December 31, 1977, 938 NEPA cases had been filed against the federal agencies surveyed. Since NEPA's enactment 8 years ago, more than 10,000 EISs have been filed, and many times that number of environmental assessments have been made each year. (p. 407)

CHAPTER 10 ECONOMICS

- Over the past several years 2-2½ percent of the gross national product has been spent on pollution control programs. (p. 418)
- Although dollar estimates of the benefits and costs of control contribute to budget decisions, they are not automatic guides. Qualitative judgments are still required because it is not possible to quantify all the values of either the benefits or the costs. There are too many uncertainties, particularly about benefits. (p. 419)
- Comprehensive estimates of the benefits of environmental programs are still lacking . . . . However, a recent American Lung Association evaluation of existing studies on the health costs of air pollution suggests that they have been underestimated and that they could currently amount to as much as $10 billion per year in the United States. (p. 419)
- A study undertaken for CEQ estimated that, in a particular subset of air pollution damages, we are already experiencing benefits of approximately $5 billion per year, an amount that should double by 1985. (p. 420)
- The analysis covers only a part of the total estimated damage costs for air pollution. For methodological reasons, a majority of the damage cost categories had to be omitted. . . . If the relationship between the potential damages . . . and actual damages . . . is the same for all categories of damage costs as it is for those that were analyzed, the total benefits of the [air] pollution control programs . . . [for 1977] would be $22 billion. (p. 420)
- Unfortunately, it is impossible with the present state of knowledge to make [benefit] estimates for water pollution damages; there the uncertainties are even greater. (p. 421)
- This year's Bureau of Economic Analysis survey indicates that business is expecting to invest $7.1 billion for pollution control, up 3 percent from last year . . . . Measured in constant dollars, this 3 percent increase represents an actual decline in real expenditures. An estimated $6.3 billion is being invested in municipal waste water treatment, compared to $5.4 billion in 1977. . . . [W]hen measured in constant dollars—the increase is only 6 percent. (p. 421)
- The Council estimates that on the whole, including government and private expenditures, the nation is spending $47.6 billion for pollution control in 1978, approximately $215 per capita. Of this amount, only $22.7 billion is in response to environmental legislation; the remainder would have been spent without it. Spending in response to legislation has increased 20 percent since 1977, but corrected for inflation the increase is approximately 12 percent. (p. 424)
- The cost estimates for 1978 do not yet include many costs associated with environmental legislation enacted during the past 1 or 2 years

. . . . For most of this legislation EPA is still in the process of developing its final regulations, and the costs will not be felt until businesses and government begin to implement the regulations. (pp. 424–25)

- On the basis of preliminary, incomplete assessments, EPA estimates the costs of complying with the technical specifications of [the Resource Conservation and Recovery Act of 1976] at approximately $377 million per year, which will add less than 1 percent to prices in the most heavily affected industries. Few plant closures are expected. (p. 425)
- There are no estimates of the total costs of the Toxic Substances Control Act as it was finally passed by the Congress in 1976. They will depend on the manner in which the Act is implemented, and EPA considers it too early to estimate such costs accurately. (p. 427)
- [T]his year's projection of incremental abatement costs (the additional costs resulting from federal environmental regulations beyond what would otherwise have been spent) totals $361.3 billion for 1977 through 1986; 59 percent, $213.6 billion, is for air pollution control and 35 percent, $124.7 billion, is for water pollution control. (p. 428)
- The incremental real resource abatement costs (investment plus O&M less taxes) are estimated to amount to approximately 2.15 percent of the gross national product in 1978. This is the same as the estimate for 1977. . . . The proportion is expected to level off through 1983 as investment costs and GNP grow at similar rates; it will then decrease because after 1983 all existing plants should have made the necessary investment to comply with pollution control requirements. (p. 430)
- A recently completed macroeconomic analysis sponsored by CEQ and EPA analyzed the impacts of pollution control programs on unemployment as well as on a number of other variables. This analysis . . . indicates that these programs have very little net impact on the unemployment rate. (p. 431)
- In 1977, less than one-half of 1 percent of the companies in [a Department of Commerce] survey reported a plant closing [associated with pollution control requirements]. This figure amounted to 12 facilities in 1977 —about one-half of the 1976 figure. Most permanent closings did not occur solely as a result of environmental regulations. (p. 432)
- The problem of plant closings should not be understated, however. There is some geographical concentration of the plants which have closed, and many are located in older industrial towns already suffering relatively high unemployment rates. (p. 432)
- The Council and EPA also sponsored a macroeconomic analysis to determine the impacts of pollution control expenditures on economic growth. . . . The CEQ-EPA analyses indicate that every dollar of pollution control expenditures displaced only 33-40 cents of other plant and equipment investment. (p. 434)
- The CEQ-EPA analysis [showed] extra inflation rates of 0.0-0.4 percent per year resulting from spending for pollution control. (p. 435)
- Two recent studies support earlier studies that evidence of industry-specific impacts on trade and the balance of payments from pollution has not been found. (p. 436)
- [T]he general public benefit of rapid, substantial improvement in environmental quality may entail burdensome costs to a few firms or communities. A number of programs have been established to provide economic assistance that will help avoid or at least mitigate these impacts. . . . [A] CEQ-led task force found that although the existing programs seem adequate in most instances, they should be made more accessible to potential recipients. (p. 441)

- With the increased concern about inflation, unemployment, and the balance of payments, increased attention has been given to the economic implications of government regulatory programs. . . . Implementation of the newer [regulatory] programs is formally reviewed by the Regulatory Analysis Review Group . . . . (p. 444)

CHAPTER 11 THE GLOBAL ENVIRONMENT

- [D]evelopment is essential for the improvement of living standards and quality of life for the world's poorest peoples. . . . [E]conomic development cannot succeed unless development planning includes careful attention to the natural environment. (p. 450)
- [T]he 18 countries with per capita gross national products lower than $100 . . . record the highest infant mortality rates and the lowest life expectancies in the world. (p. 451)
- Unfortunately, about half the people in the developing world have failed to enjoy the benefits of recent improvements in income and quality of life. . . . This lack of progress in many places means that 1.2 billion of the world's 4 billion people continue to lack access to safe water supplies and public health facilities, 700 million remain seriously malnourished, 550 million still cannot read or write, and 250 million who are living in urban areas lack decent shelter. (p. 454)
- The physical environment surrounding the poor is inevitably abused. People at the margin of existence cannot afford the luxury of conserving for the future but must take wood for fuel and heat where they find it, let livestock graze on whatever land there is to be found, and work the land to exhaustion in putting food on their tables. (p. 454)
- In recent years . . . developed and developing nations alike have come to recognize that adverse environmental impacts can result inadvertently from the development process itself and can endanger its results. (p. 456)
- [M]ost of the world's drylands are considered to be at "high risk" or "very high risk" of losing their ability to support useful species of plant and animal life. As much as 30 percent of the earth's land surface, covering parts of 100 nations and occupied by one-sixth of the world's population, is designated as at least "threatened." (p. 464)
- One important way that [people] contribute to long-term desertification is by increasing livestock and cultivation during the high rainfall years to levels that cannot be sustained—and can accelerate the breakdown of thin dryland soils—in average or drought years. (p. 466)
- Much of [mankind's] shared wildlife resource is found in the developing countries. Its protection for the benefit of people throughout the world sometimes poses difficult economic decisions and often requires the commitment of financial resources that exceed the capability of these countries. (p. 469)
- Short-term threats to the survival of wild African game include competition from cattle for food at the edges of the great parks and the nearby watering holes, the creeping expansion of farms along park borders (sometimes blocking important migratory paths), and the guns and traps of poachers, who take tens of thousands of animals from game parks each year. (p. 470)
- International trade in wild animal products and, to a minor extent, in live wildlife also threatens the survival of some species. (p. 471)
- Approximately 250 million hectares (625 million acres)—13 percent of all cultivated lands—are irrigated. . . . [But u]nless special care is exercised, alterations in the level of water tables, rate of salt leaching,

and flow of natural waterways can cause irrigated lands to turn into wastelands. (p. 472)

- [I]n many parts of the developing world, vast expanses of land are being lost to human use, primarily through deforestation and . . . desertification. (p. 458)
- The world's closed forest was reduced by more than 500 million hectares . . . , 15 percent, in the decade between 1963 and 1973. In the less developed countries, forest depletion is occurring at a much faster rate . . . . (p. 459)
- As the distance that fuel must be carried grows, the cost rises; currently the average Ouagadougou laborer spends 20 percent of his meager income (some $14 out of $70) for fuelwood each year. In Bamako, Mali, and Niamey, Niger, the share of income spent for fuelwood is one-quarter. By contrast, the average family in the United States spent only 6 percent of its income to meet all its energy needs in 1973. (p. 460)
- The combined effect of farming, fuel cutting, and timbering in the Himalayan foothills has left naked slopes to erode in the annual monsoon season, causing frequent and widespread flooding in Pakistan, India, and Bangladesh and filling lakes and rivers throughout the lowlands with millions of tons of silt. (p. 461)
- The most fundamental problem behind the failure of reforestation programs . . . is the continued unavailability to poor people of the most basic requirements for living. (p. 462)
- AID expects to undertake forest programs in five countries of Sahelian Africa in the near future and is planning to commit as much as $20 million in fiscal year 1978 for small-scale renewable energy projects. (p. 463)
- After 60 years of irrigation in the Indus River valley of Pakistan, 90 percent of the lands involved were subject to waterlogging and 20 percent were seriously affected by salinity . . . . A number of national governments and international organizations have undertaken projects to rehabilitate damaged lands, with varying degrees of success. (p. 474)
- Waterborne diseases are a particular problem in the less developed nations . . . . Ironically, . . . such diseases often spread in the wake of water resource development projects that are intended to provide important benefits, including the expansion of agricultural lands through irrigation . . . . (p. 476)
- The World Health Organization reports that as of 1975, 1.2 billion people (almost two-thirds of the population of the developing countries) lacked access to clean water supplies, and 1.4 billion lived without even simple waste disposal systems. "As a result," a Worldwatch Institute report stated, "environmental pollution by untreated human waste exacts a disease and death toll that dwarfs the known toll of industrial pollutants." (p. 479)
- Massive migrations to towns and cities accelerate as rural populations increase, rural employment fails to keep pace, and urban industrial jobs pay better wages. In the poorest nations—those with per capita gross national products lower than $100—populations generally grew at an average annual rate of 2.3 percent in 1970, while urban population grew at 4.4 percent annually. (p. 480)
- In 1975, 190 million urban dwellers lacked access to basic amenities such as decent housing, clean water, sanitation, and medical care although 40 million of this number were theoretically able to afford these things. (p. 482)

- No realistic level of large-scale industrial development could keep pace with the growing urban populations and work forces of the less developed countries. (p. 482)
- Urban problems in the developing world have their roots in the population explosion that strains Third World resources. (p. 484)
- The United States and other developed nations and organizations cannot and should not impose a particular set of values—environmental or otherwise—on the emerging nations of the world. Their responsibilities lie rather in providing adequate information to these nations so that they may make their own choices regarding the possibilities of environmentally sound technologies and the level of environmental protection that they can afford at the time. (p. 485)
- [There is] evidence that birth rates are beginining to decline slightly in an increasing number of developing countries, in some cases overtaking declines in death rates. The decline is 0.1 percent from the high of 2.6 percent in the early 1970's to 2.5 percent in 1976. (p. 486)
- [T]he worst oil spill in maritime history occurred in the English Channel. On March 17, the oil tanker *Amoco Cadiz* went aground 2 kilometers off Portsall on the Brittany coast of France. Efforts to stop the spill or contain it were unsuccessful. . . . [T]he entire cargo of 216,000 tons of crude oil was spilled, polluting the waters and shoreline along 200 kilometers (124 miles) of the coast and 60 kilometers (37½ miles) out to sea. (p. 487)
- The Seventh Session [of the Law of the Sea Conference] produced significant improvements in the informal negotiating text on the prevention, reduction, and control of pollution from ships. (p. 489)
- [I]t remained to be seen whether the sharply differing views in many areas, including a deep sea mining system, . . . could be reconciled in a follow-on session . . . . (p. 489)
- The Convention for the Protection of the Mediterranean Sea against Pollution entered into force in February 1978, 2 years after its signature . . . . A . . . protocol on problems of land-source pollution is . . . difficult for the Mediterranean nations to agree upon because of the economic implications of measures to reduce discharges of pollutants from factories, cities, and tourist resorts. (p. 490)
- Three important United Nations-sponsored conferences were held in 1977, one on environmental education in addition to those on water and desertification . . . . (p. 492)

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CHAPTER 1

AIR QUALITY

Clean air remains a principal goal on the nation's environmental program. Taking account of experience and progress so far, the Clean Air Act Amendments of 1977 [1] set new deadlines for cleaning up polluted areas, added protection for clean air areas, and required review of existing air quality standards (one revision, for photochemical oxidants, was proposed in June 1978[2]).

Most urban areas have yet to achieve the existing standards for all five "criteria" pollutants.* The overall trend in most areas is toward continued improvement. For photochemical oxidants and carbon monoxide—the most troublesome pollutants in U.S. cities—air quality improved significantly over the 4 years 1973–76 in most cities which have severe problems and for which data are available. In these cities both the frequency and severity of pollution exceeding federal standards have declined. Simultaneous violations of total suspended particulate and sulfur dioxide standards are rare, occurring only in a few lightly populated areas.† Of the five criteria pollutants, only nitrogen dioxide showed no trend of improvement since the national ambient standards were set. When more stringent emission controls for autos take effect in 1981, improvements are expected.

The 1977 Clean Air Act Amendments require the states by January 1979 to design programs for achieving national ambient standards for areas that do not now meet the standards.[3] The new congressional deadline is December 1982, but states with severe oxidant or carbon monoxide problems may have until 1987 to achieve standards for these automobile-related pollutants. State programs must also maintain air quality in areas where national standards

---

* The criteria pollutants, subject to primary standards established to protect human health, are: sulfur oxides, total suspended particulates, carbon monoxide, photochemical oxidants, and nitrogen dioxide.

† Particulate and sulfur dioxide standards were based on studies in which health effects were observed when levels of both pollutants were high; subsequent studies have shown that the effects are more closely associated with sulfate aerosol levels. See Council on Environmental Quality, *Environmental Quality—1976: The Seventh Annual Report of the Council on Environmental Quality*, pp. 216-17.

have been met, and they must protect clean air areas from significant deterioration in air quality.

Enforcement efforts are focusing on major sources in a few large industries—chiefly electric utilities, iron and steel mills, and primary nonferrous smelters—which have disproportionately high rates of noncompliance. Compliance with emission limitations in these industries is well below the 94 percent compliance level for major sources overall. In some heavily populated areas, a few facilities in these industries singlehandedly cause national ambient standards to be violated. About 83 percent of federal facilities meet applicable standards and limits.[4]

For other "noncriteria" pollutants, improved monitoring is being put in place, and research on health effects is continuing. Although health risks for sulfates, nitrates, and trace metals have not yet been quantified, data now available show that concentrations of these pollutants are higher than average in some regions with dense populations. For hazardous pollutants for which national emission standards have been established (asbestos, beryllium, mercury, and vinyl chloride), the vast majority of affected sources are in compliance.[5]

The air quality analysis this year concentrates primarily on urban air pollution with effects on human health. Regional and global air pollution problems not directly related to health (in particular, acid precipitation and possible global climate changes) were treated in last year's Annual Report.[6]

NATIONAL AMBIENT AIR QUALITY STANDARDS

By December 31, 1980, EPA must review all the health-related national ambient air quality standards which were established in 1970–71.[7]

PHOTOCHEMICAL OXIDANTS

The existing national primary ambient standard for oxidants is 0.08 parts per million. Epidemiological and other studies have not shown respiratory irritation in sensitive people, for example, asthmatics, at ozone concentrations below 0.15–0.25 parts per million.[8] This range is higher than levels which in 1970 were thought to cause respiratory difficulties for asthma sufferers.

The Clean Air Act requires the Administrator to set a standard which will protect public health, allowing for an adequate margin of safety.[9] As a result of its reevaluation of health effects information, EPA proposed to revise the oxidant standard slightly, to 0.10 parts per million, and to redesignate the standard from oxidants to ozone,[10] which is a good indicator of total oxidants. Because of the magnitude of the nonattainment problem, the proposed relaxation would do little to ease the need for controls on stationary sources of

hydrocarbon emissions in the worst polluted cities. (Hydrocarbons combine with nitrogen oxides in sunlight to form photochemical oxidants, including ozone.) Automobile emission standards would not be relaxed.

TOTAL SUSPENDED PARTICULATES

EPA has begun to reexamine the use of total suspended particulates as a measure of public health risk. There is concern in the scientific community that a standard based on overall TSP present in the air, without regard for the size of particles or their chemical composition, may not be the most appropriate index of public health impact. Consequently, as part of the effort to reassess TSP standards by December 1980, EPA is exploring the possibility of a standard based on particles small enough to be inhaled.[11]

The first step is to define the size limit of particles in the ambient air which are capable of being inhaled. Based on an analysis of particle deposition in the respiratory tract, EPA believes that particles less than 15 micrometers should receive emphasis in ongoing research programs.[12] EPA plans to conduct health effects research in order to establish a quantitative link between these small particles and public health. In addition, EPA is establishing a nationwide monitoring network to determine where and at what levels inhalable particulate problems exist; the chemical composition of airborne particulates (e.g., sulfates, nitrates, heavy metals) will also be examined.

If a primary health-related standard for inhalable particulates in the ambient air should supplant the present TSP standard, emission controls for larger particles could still be necessary. Even though larger particles may not be health risks, they can cause soiling, property damage, and other adverse welfare effects. The secondary TSP standard, which would necessarily change if a primary inhalable particulate standard were promulgated, is intended to protect against these impacts.

SULFUR OXIDES—SULFATES

Issuance of a primary standard for sulfates does not appear likely in the immediate future. Clinical studies show health effects from sulfuric acid and other sulfates,[13] but at higher levels than are typically observed in the ambient air. Since 1975, when EPA concluded that preliminary data on atmospheric sulfates and observed human health effects were insufficient to warrant a major sulfate regulatory program,[14] few new data on health effects have been developed to change the evaluation. Data on concentrations of sulfates in the atmosphere are also insufficient. Continuing research has increased concern, however, about the relationship of sulfates to visibility and acid precipitation.[15]

EPA plans to revise the criteria for sulfur oxides in parallel with revisions of the particulate matter criteria.

NITROGEN DIOXIDE

EPA is required by the 1977 Clean Air Amendments to adopt a short-term ambient air quality standard for nitrogen dioxide unless it finds that a standard is not needed to protect public health.[16] The present standard applies only to annual average exposures.

LEAD

Pursuant to a court order in *NRDC et al.* v. *Train*,[17] EPA proposed a national ambient air quality standard for lead in December 1977.[18]

Lead exposure comes chiefly by ingestion and inhalation. The aggregate contribution of lead from all sources—auto emissions, industrial emissions, dust, food, drinking water—poses a significant threat to health. Effects range from impairment of biochemical processes in the body at blood levels as low as 10 micrograms of lead per deciliter of blood to the occurrence of encephalopathy at higher levels. Young children and pregnant women are among the most sensitive.

Setting an air quality standard is very difficult because lead in the air is not the only major source of exposure. EPA must estimate a contribution to blood lead levels from nonair sources. In fact, the nonair exposure varies widely. Thus a national air quality standard will be overprotective in some areas and underprotective in others.

EPA proposed a standard of 1.5 micrograms of lead per cubic meter monthly average, based on a goal for a mean population blood lead level of 1.5 micrograms of lead per deciliter of blood in children. The proposal assumes that 15 micrograms per deciliter of blood lead causes adverse health effects and that 3 micrograms per deciliter comes from air sources.[19]

AIR QUALITY CONDITIONS AND TRENDS

CRITERIA POLLUTANTS

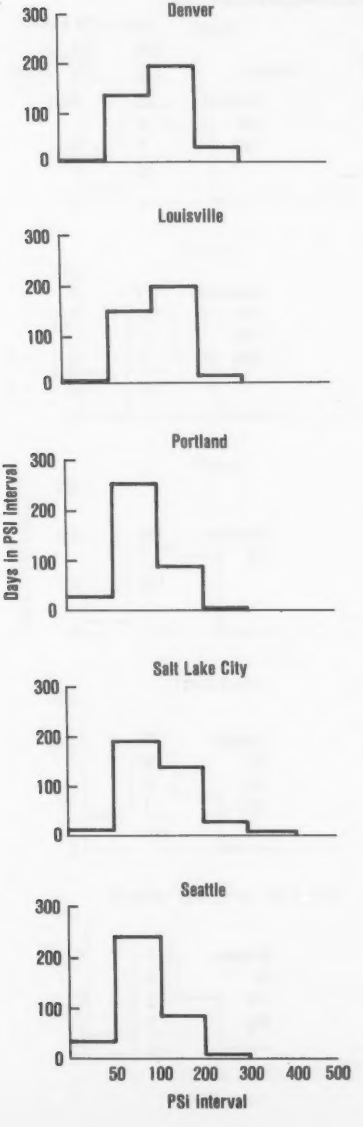
The Pollutant Standards Index, which makes it possible to show pollution levels on a uniform basis throughout the nation, has now been adopted by 24 states and 100 localities, including the Southern California Association of Governments, which reports on daily air quality levels for the Los Angeles basin.[20] Uniform reporting nationwide is assured in the future by the Clean Air Act Amendments of 1977, which require all Air Quality Control Regions to adopt the PSI by August 1978.[21]

The PSI is an indicator of daily maximum pollution levels; the figure is above 100 when any of the five criteria pollutants reaches a level considered to affect human health adversely.[22] Daily PSI values for 43 of the nation's 60 most densely populated areas with adequate data are shown in Figure 1–1; the cities included are those

Figure 1-1

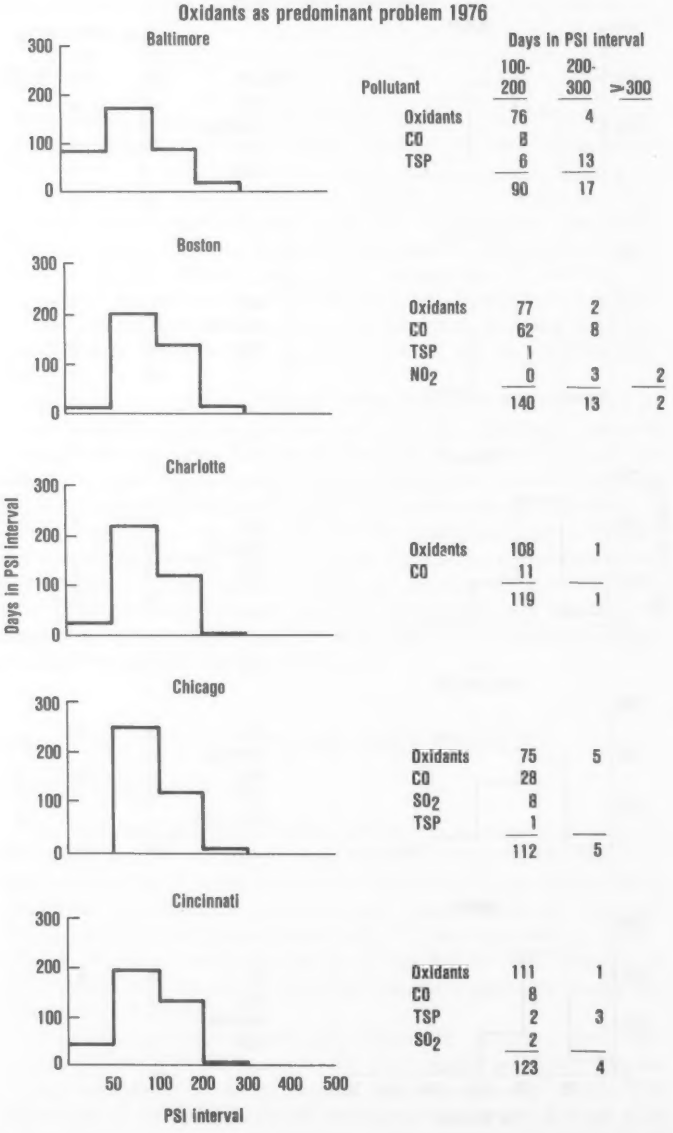
PSI Distributions in 43 Cities Classified by Predominant Pollutant 1976 (or 1975)[1]

CO as predominant problem



Pollutant	Days in PSI interval 100-200	200-300	>300
Denver			
CO	121	29	
Oxidants	75	1	
TSP	2	1	
NO_2	0	1	
	198	32	
Louisville			
CO	111	12	
Oxidants	68		
SO_2	20	2	
	199	14	
Portland			
CO	73	1	
Oxidants	12		
TSP	1	1	
	86	2	
Salt Lake City			
CO	58	9	
Oxidants	40		
SO_2	33	12	3
TSP	8	1	1
SO_2 × TSP	—	2	1
	139	24	5
Seattle			
CO	84	5	
SO_2	2		
Oxidants	1		
TSP	1		
	88	5	

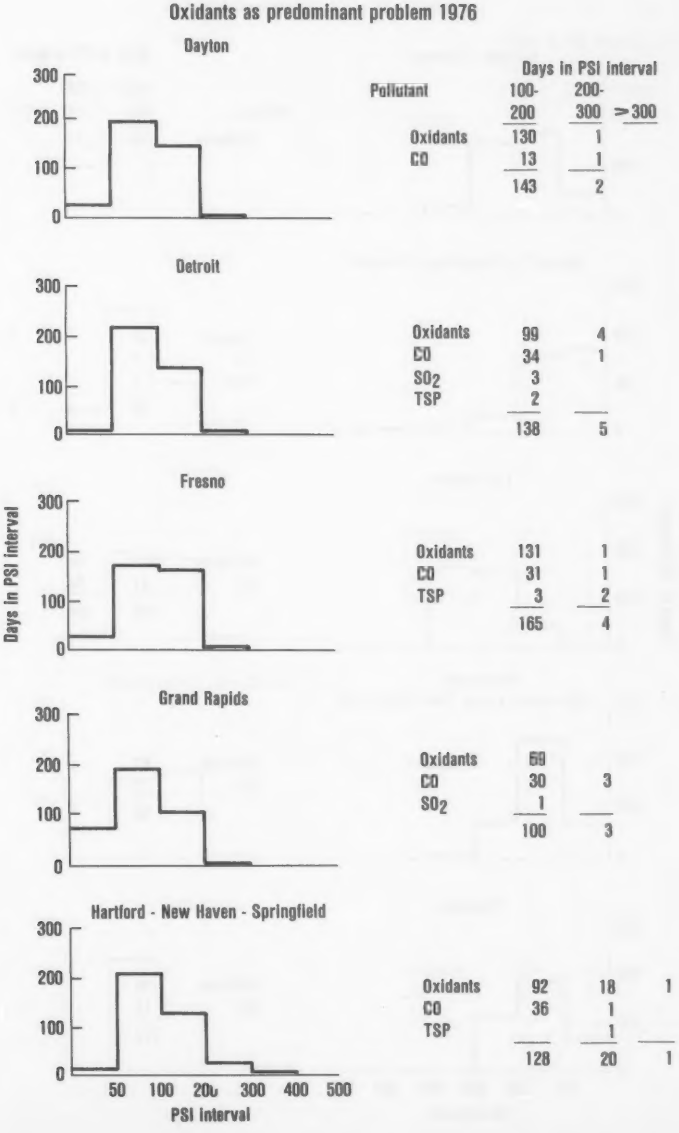
Figure 1-1 (continued)



Oxidants as predominant problem 1976

	Days in PSI interval		
Pollutant	100-200	200-300	>300
Baltimore			
Oxidants	76	4	
CO	8		
TSP	6	13	
	90	17	
Boston			
Oxidants	77	2	
CO	62	8	
TSP	1		
NO_2	0	3	2
	140	13	2
Charlotte			
Oxidants	108	1	
CO	11		
	119	1	
Chicago			
Oxidants	75	5	
CO	28		
SO_2	8		
TSP	1		
	112	5	
Cincinnati			
Oxidants	111	1	
CO	8		
TSP	2	3	
SO_2	2		
	123	4	

Figure 1-1 (continued)



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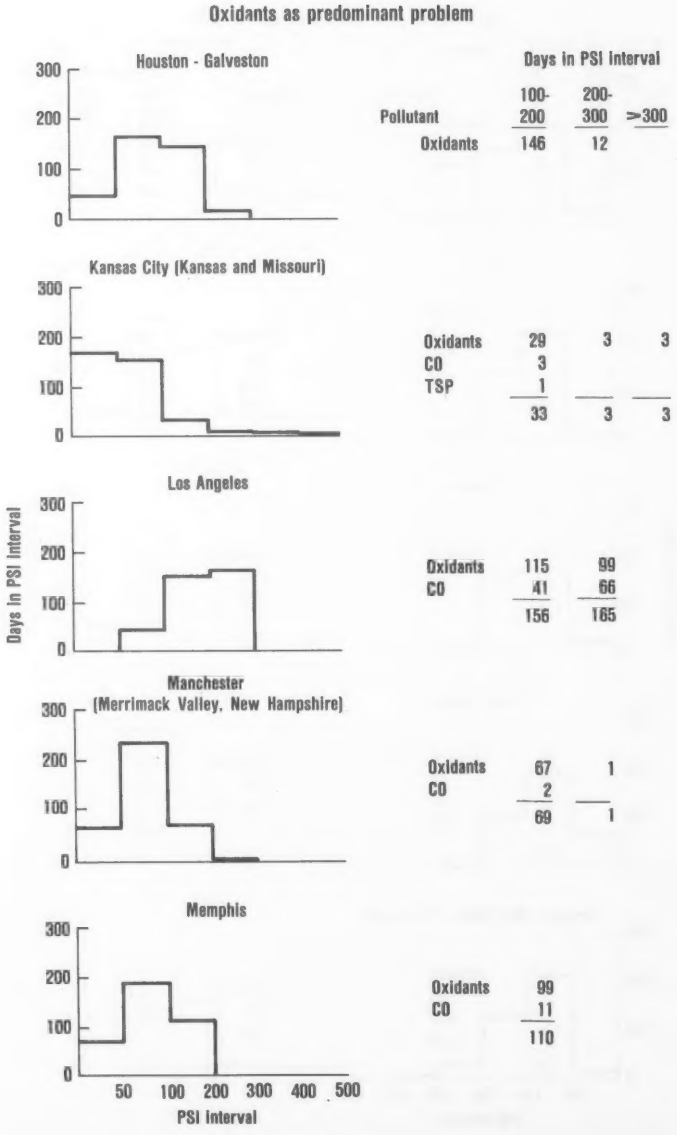

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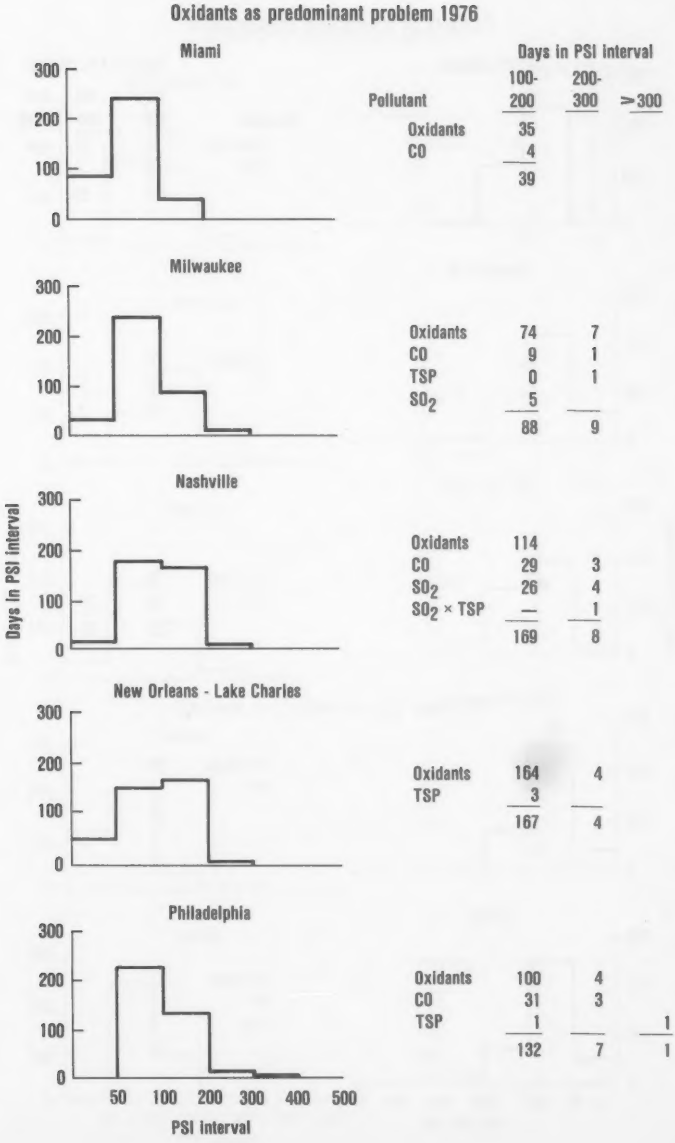

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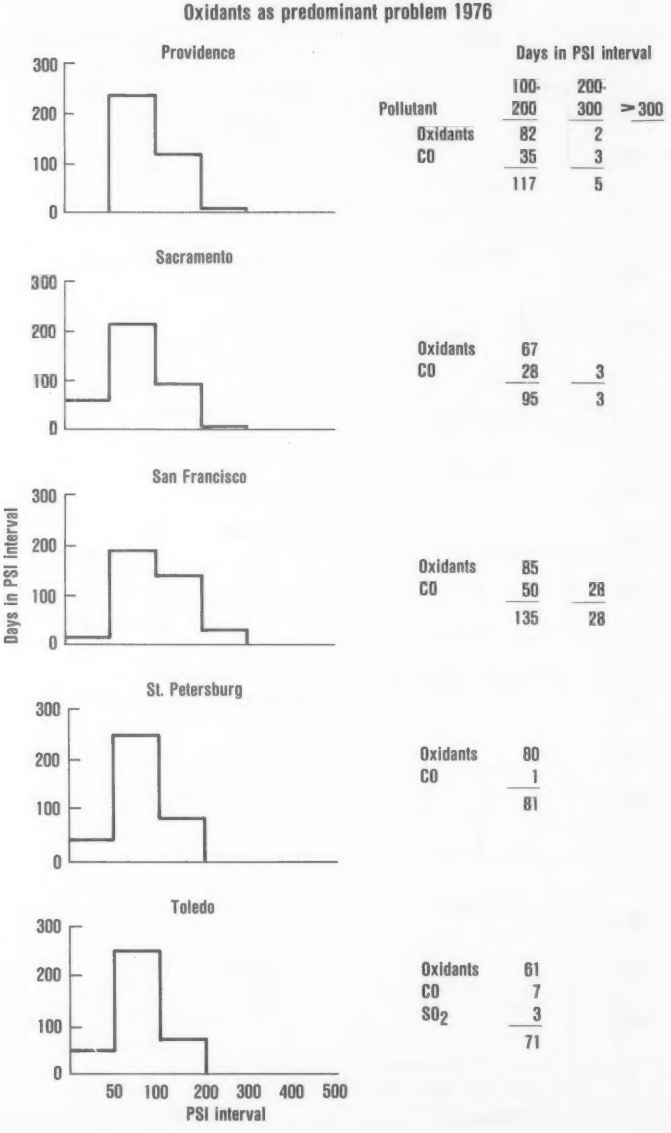

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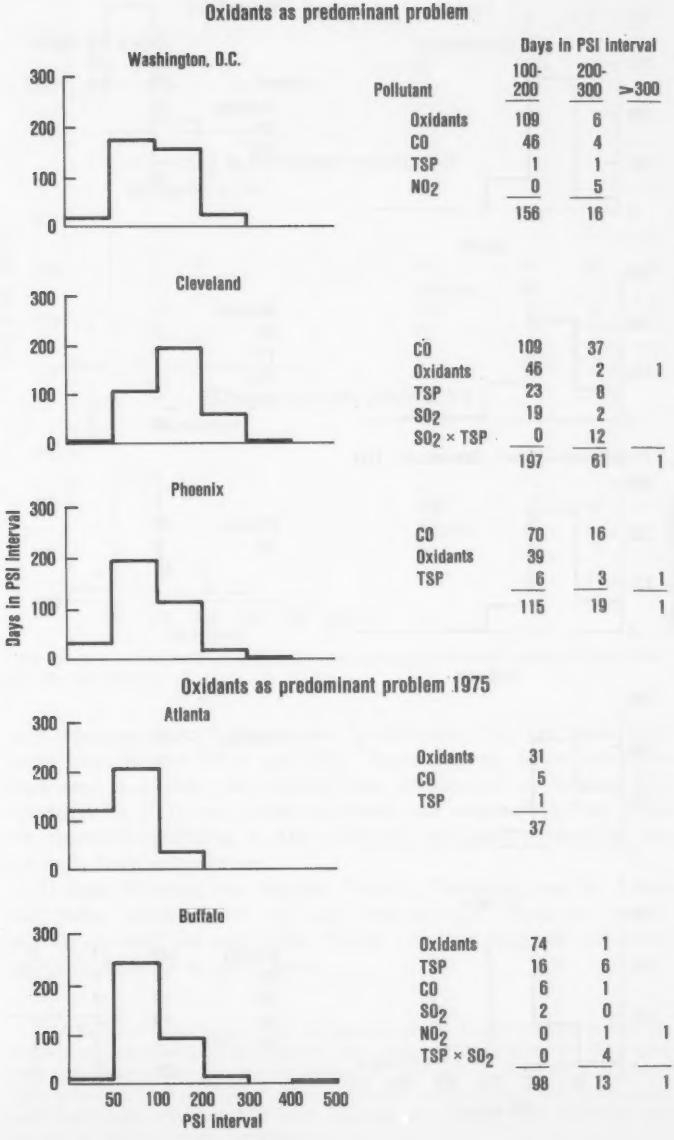


Oxidants as predominant problem

Pollutant	Days in PSI interval 100-200	200-300	>300
Oxidants	109	6	
CO	46	4	
TSP	1	1	
NO_2	0	5	
	156	16	

CO	109	37	
Oxidants	46	2	1
TSP	23	8	
SO_2	19	2	
$SO_2 \times TSP$	0	12	
	197	61	1

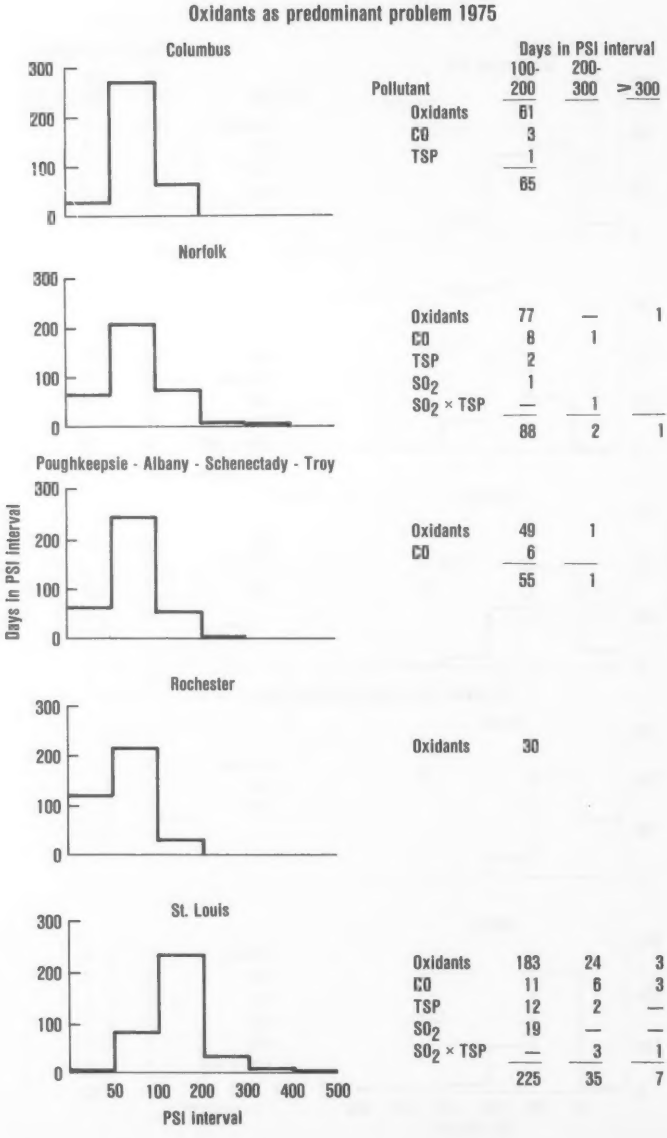
CO	70	16	
Oxidants	39		
TSP	6	3	1
	115	19	1

Oxidants as predominant problem 1975

Oxidants	31
CO	5
TSP	1
	37

Oxidants	74	1	
TSP	16	6	
CO	6	1	
SO_2	2	0	
NO_2	0	1	1
$TSP \times SO_2$	0	4	
	98	13	1

Figure 1-1 (continued)



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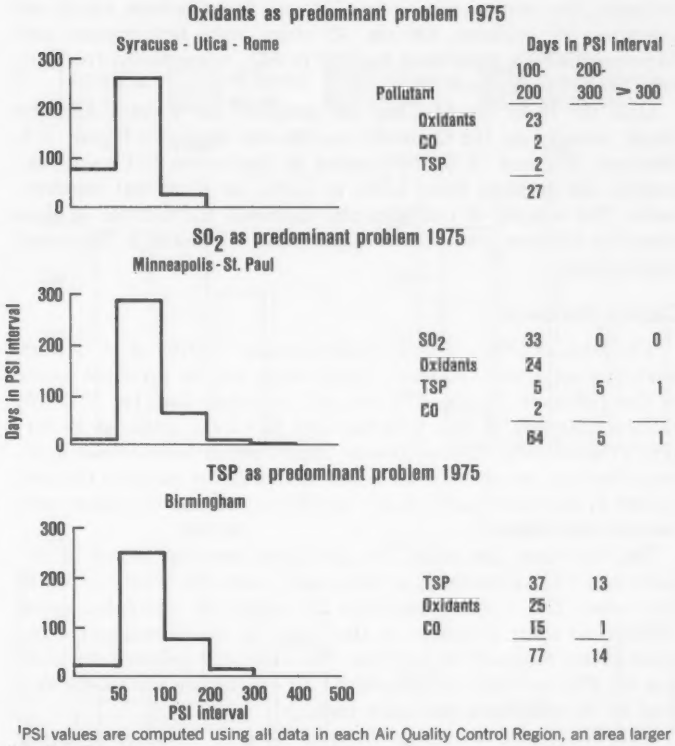


[1]PSI values are computed using all data in each Air Quality Control Region, an area larger than the city proper.

with adequate data.* The figures beside each diagram show how many days during 1976 (or 1975, depending on when adequate data were available) air quality was unhealthful or worse (PSI values above 100) and which pollutant was responsible. The cities are classified according to the pollutant primarily responsible for the high daily index values.

Of these 43 cities, Los Angeles, Denver, Cleveland, and St. Louis had index values above 100 (the "unhealthful" range or worse) at least one-half the year 1976. All the cities experienced unhealthy air quality for 27 or more days.

* "Adequate" data means that a majority of the health-related pollutants were being monitored at one site or more, there is a minimum of 300 daily observations per year for carbon monoxide and ozone, cities with SO_2 and NO_2 problems also met the 300-day coverage requirement, and those cities with high daily levels of TSP were assumed to monitor with sufficient frequency to describe such problems.

The figures show the predominance of oxidants and carbon monoxide in urban air pollution. Both are caused by motor vehicle emissions, but stationary sources also emit hydrocarbons which are precursors of oxidants. Of the 43 cities, only Birmingham and Minneapolis were dominated by TSP or SQ_2, respectively, from uncontrolled industrial sources.

Data for 16 of the 43 cities are complete for 4 years, and the trends revealed by the Council's analysis are shown in Figure 1–2. Between 1973 and 1976, the number of days when PSI values exceeded 100 declined from 2,545 to 2,334, an 8 percent improvement. The severity of pollution also declined; the number of days when the PSI rose above 200 dropped from 447 to 318, a 29 percent improvement.

Carbon Monoxide

The positive effect of automobile emission controls is clear from analyzing monitored CO levels. Automobiles are the principal source of this pollutant. In the 13 cities with complete data for 1973–76, the total number of days with harmful CO levels declined 36 percent (Figure 1–3). The aggregate data tend to balance out influences that are not related to emissions standards, for example, changes caused by increased traffic near a monitoring station or year-to-year variations in climate.

The combined data show that the overall severity as well as frequency of CO violations have decreased markedly. The number of days when CO levels were above 22 milligrams per cubic meter dropped to zero; violations in the range of 16–22 milligrams per cubic meter dropped 60 percent. (The national primary standard and the PSI indicator of unhealthful air quality are equivalent at a level of 10 milligrams per cubic meter.)

Nationwide, CO emissions dropped from 81.3 million tons per year in 1973 to 69.7 million tons per year in 1976. This 14.3 percent reduction would be expected to produce a 43 percent drop in violations. (Declines in observed levels of air pollutants generally parallel reduced emissions, but the number of annual violations of the standard tends to drop much more rapidly.[23]) The observed reduction was 36 percent. Figure 1–4 compares expected and actual improvements. The difference is probably the result of relatively minor contributions from stationary sources which did not change over the 4 years. The reasonably good agreement between predicted and observed improvements in air quality is an indication that auto emissions control is working as intended.

Despite overall trends, the cities vary somewhat because of other factors affecting CO levels. City by city, nine showed declining CO levels from 1973 to 1976, three showed no apparent change, and Los Angeles showed a small upward trend. These findings suggest that although national auto emissions standards are an important control device, additional measures such as traffic controls may be needed in some localities.

Figure 1-2

Trends in PSI Levels, 16 Cities 1973-76[1]

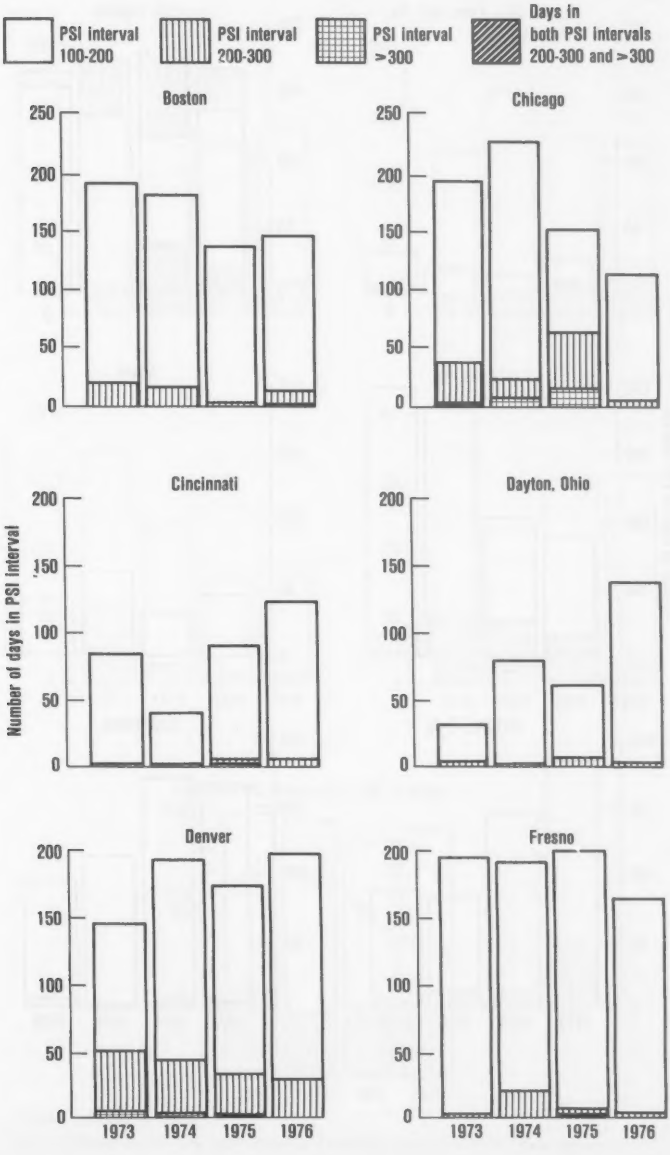
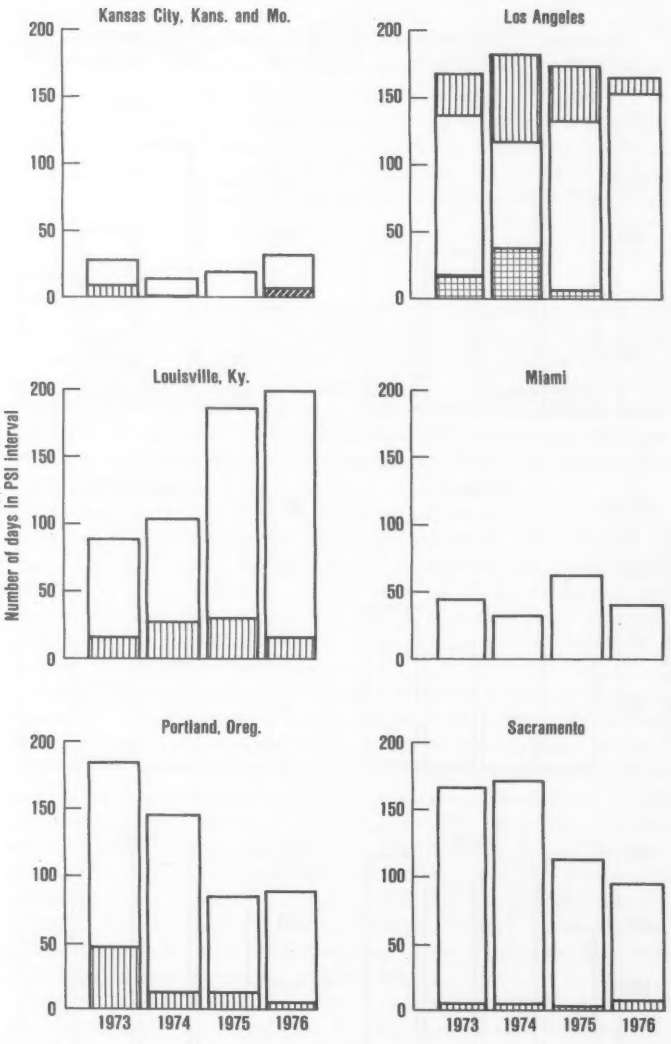


Figure 1-2 (continued)



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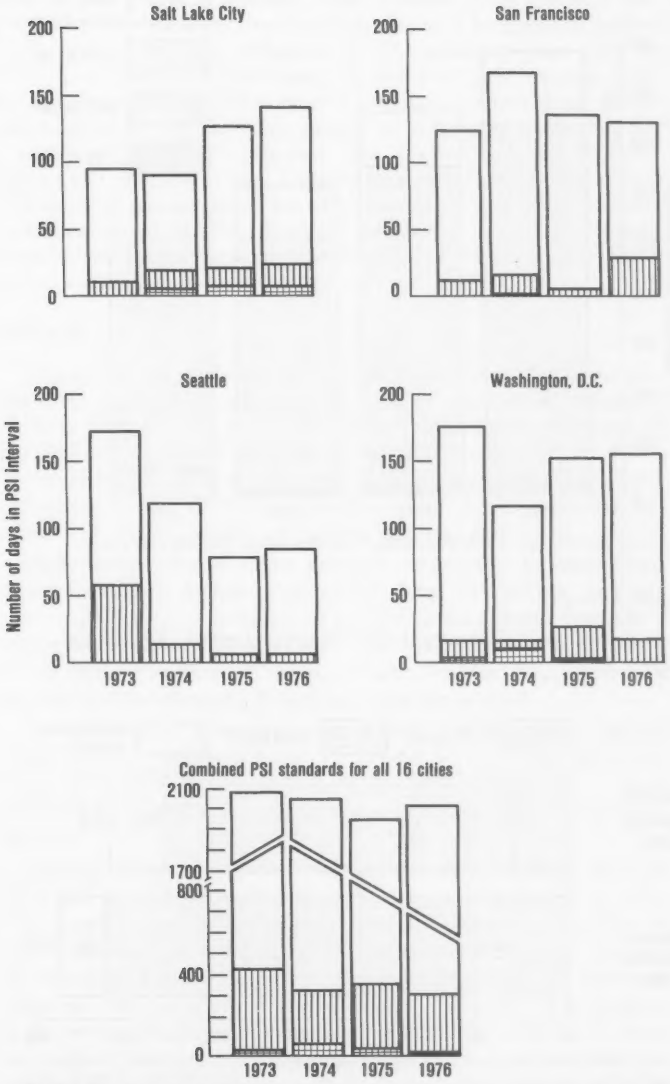
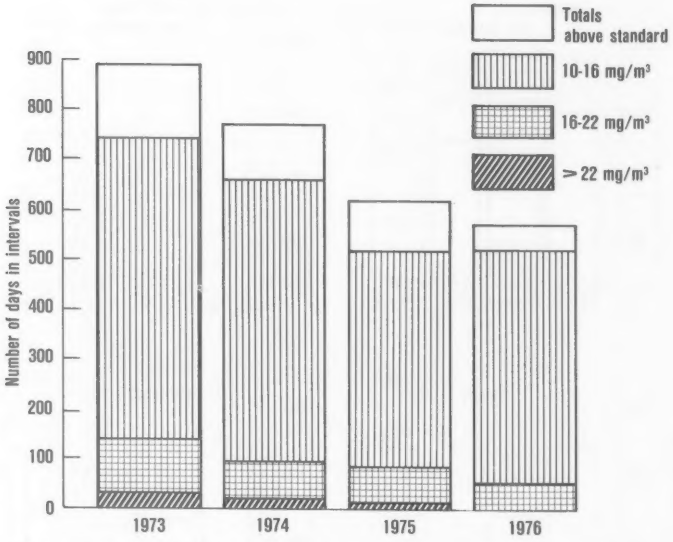


[1]Scales differ from city to city.

Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-3

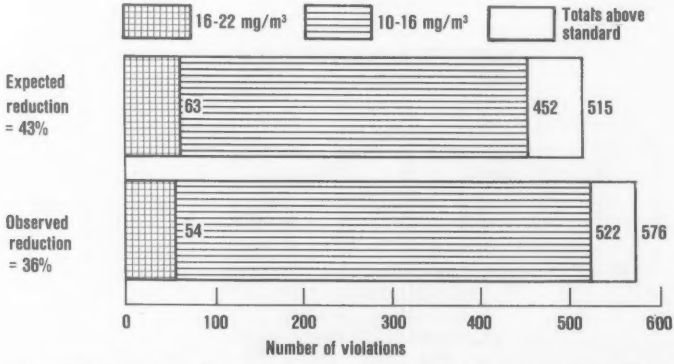
Trends in CO Levels Classified by Severity, 13 Cities, 15 Monitoring Sites 1973-76



Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-4

Observed and Expected CO Distributions[1], 13 Cities 1973-76



[1]Expected distributions calculated using proportional rollback model applied to 1973 data.

Source: Kay H. Jones, *CEQ Projections of Ozone Air Quality in 1990* (Springfield, Va.; National Technical Information Service, 1977).

The 1973–76 trends for the individual cities are shown in Figure 1–5. Figure 1–6 shows 1975–77 trends for a station in New York City. CO levels in Manhattan, although still the worst in the United States, are improving. No clear trend is observable over the past 4 years in Los Angeles, although other analyses have indicated improvements in CO levels over the past decade.[24] Increases in vehicle traffic apparently offset reductions in CO emissions from 1973 to 1976. The dramatic improvement in Portland stems mainly from the aggressive transportation control program in effect there. Selective controls to eliminate long periods of rush hour congestion are a feature of Portland's program. The controls are very effective against CO pollution, which is highly local in both cause and effect. (Similar controls are much less effective against photochemical oxidant formation. Oxidants, which are the product of regionwide emissions of hydrocarbons and nitrogen oxides, are not greatly influenced by local control strategies aimed at reducing traffic congestion.)

Oxidants

The overall national oxidant data show a definite decline in violations of standards. Combined data from 15 monitoring stations in 13 cities (Figure 1–7) show a 20 percent reduction in violations of the 0.08 parts per million oxidant standard from 1973 to 1976. Severe violations in which the level of oxidants exceeded 0.20 parts per million during the day declined 6 percent. Lesser violations, between 0.08 and 0.15 parts per million, declined 22 percent.

Hydrocarbon emissions, the principal contributor to ozone (oxidant) formation, decreased nationwide from 29.8 million tons per year in 1973 to 27.9 million tons in 1976, a 6.4 percent decrease.[25] Figure 1–8 compares expected with observed reductions in violations of the oxidant standard.[26] The agreement between the expected 18 percent and the observed 20 percent reduction is good.

As with carbon monoxide, considerable variation exists among cities. Oxidant trends for the 12 individual cities are shown in Figure 1–9. Most are consistent with the national downward trend, although Dayton diverges widely, and four cities showed no apparent change.

Dayton's reported violations more than doubled from 1975 to 1976 and in 1977 were still high—112, compared with 129 in 1976. The simplest explanation is poor data; year-to-year variations in climate normally do not cause such great annual shifts in the number of violations. Local officials feel that the recent data are accurate. Although 129 violations is second poorest nationally (Los Angeles is the worst), most of the violations are near the current 0.08 parts per million standard. Fifty-nine of the 124 ozone violations were between 0.08 and 0.10 parts per million. Dayton data were not excluded from the aggregate analysis because compensating errors in the other direction are equally probable in the remaining data.

Figure 1-5

Trends in CO Levels, 13 Cities, 15 Monitoring Sites 1973-76[1]

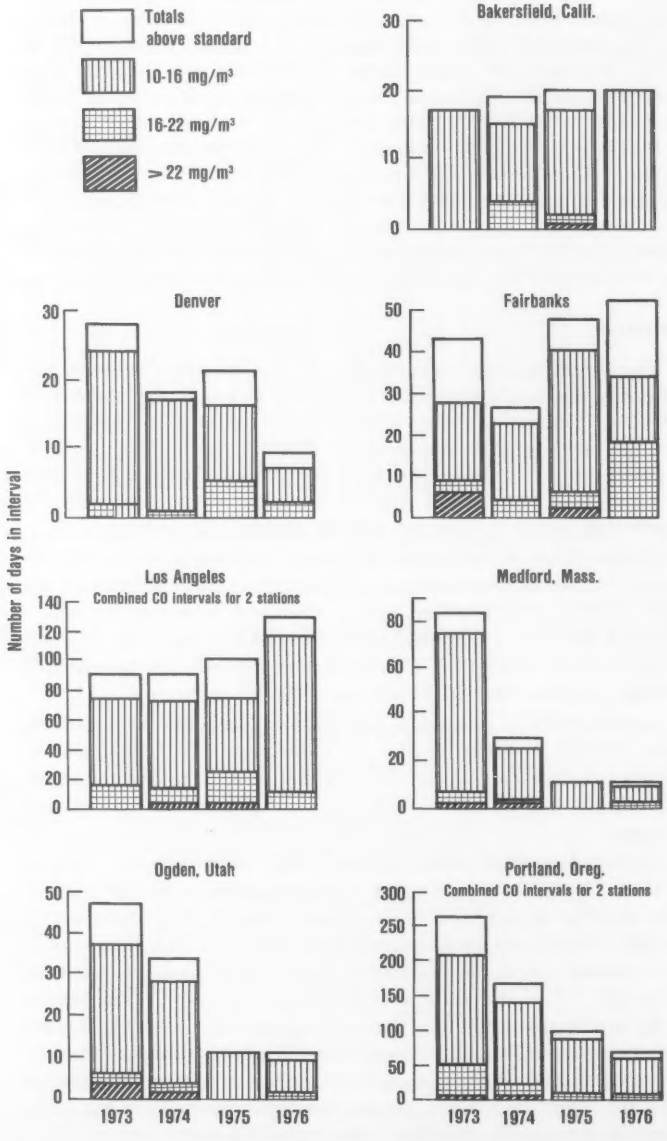
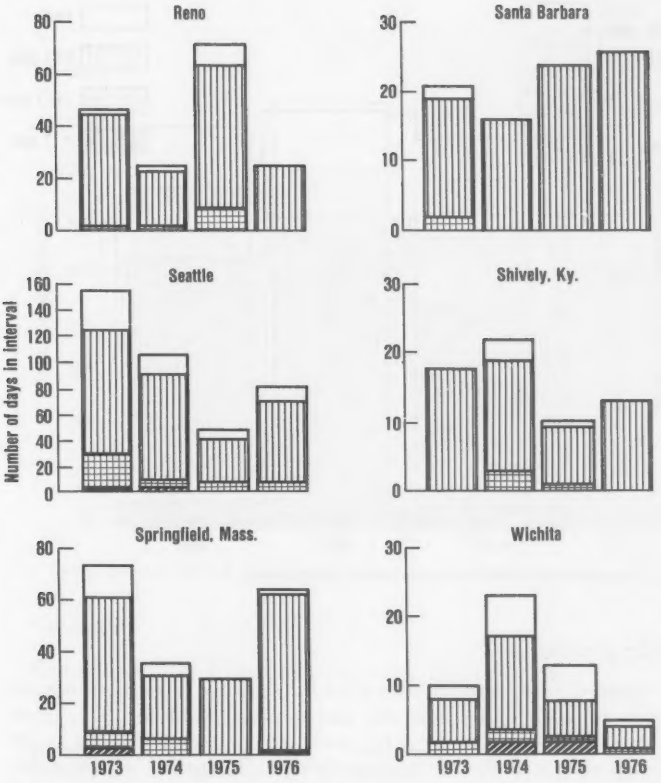


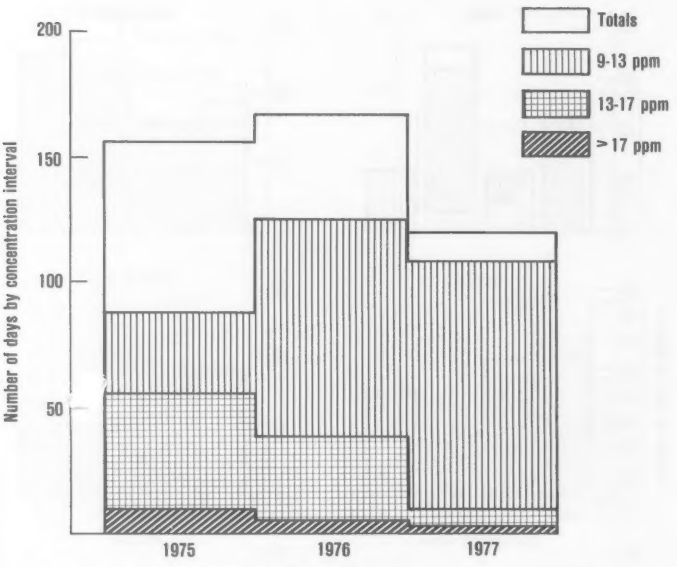
Figure 1-5 (continued)



[1]Scales differ from city to city.
Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-6

Trends in CO Levels in New York's 45th St. Station, April-January 1975-77



Source: New York State Environmental Protection Agency.

Nitrogen Dioxide

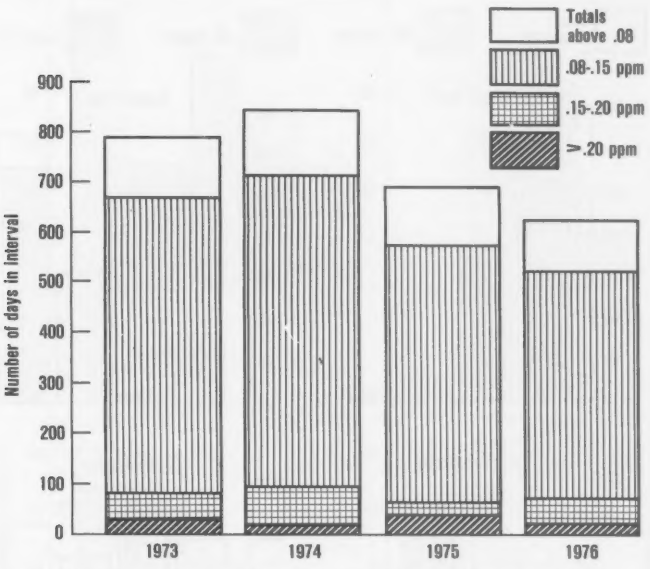
Continuous monitoring data show little change in nitrogen dioxide levels in major cities over the past 4 years. Prior to 1975, intermittent monitoring data* were unreliable; thus the Council's analysis is based on continuous monitoring data. Except in California, few continuous monitors were in place before 1973.

In the absence of a short-term standard, the trends analysis is based upon the annual average standard of 100 micrograms per cubic meter. Figure 1–10 trends of annual average NO_2 levels for the seven worst cities are based on data from the two stations in each city with the highest recorded levels. No significant trends were apparent in 1973–76 except for San Diego, where NO_2 apparently increased. Los Angeles levels reported from at least two stations were consistently above the NO_2 standard.

* EPA's intermittent NO_2 monitoring program consists of sampling at a minimum of every sixth day for a 24-hour period using a bubbler system. The results of these measurements are averaged for 1 year and then compared to the current national ambient air quality standard for NO_2.

Figure 1-7

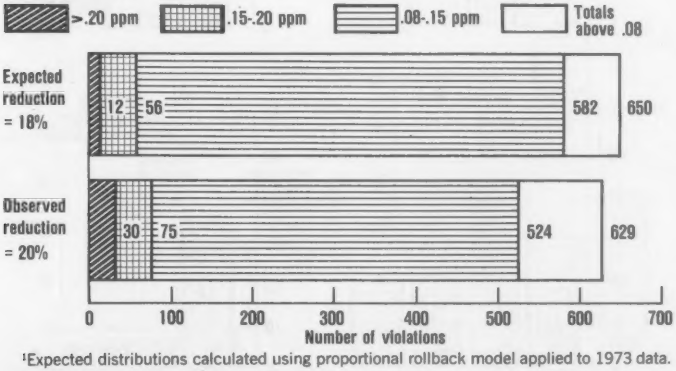
Trends in Oxidant Levels Classified by Severity, 12 Cities, 15 Monitoring Sites 1973-76



Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-8

Observed and Expected Oxidant Distributions[1] 1973-76



[1]Expected distributions calculated using proportional rollback model applied to 1973 data.

Source: Kay H. Jones, *CEQ Projections of Ozone Air Quality in 1990* (Springfield, Va.: National Technical Information Service, 1977).

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Figure 1-9

Oxidant Trends in 12 Cities, 15 Monitoring Sites 1973-76

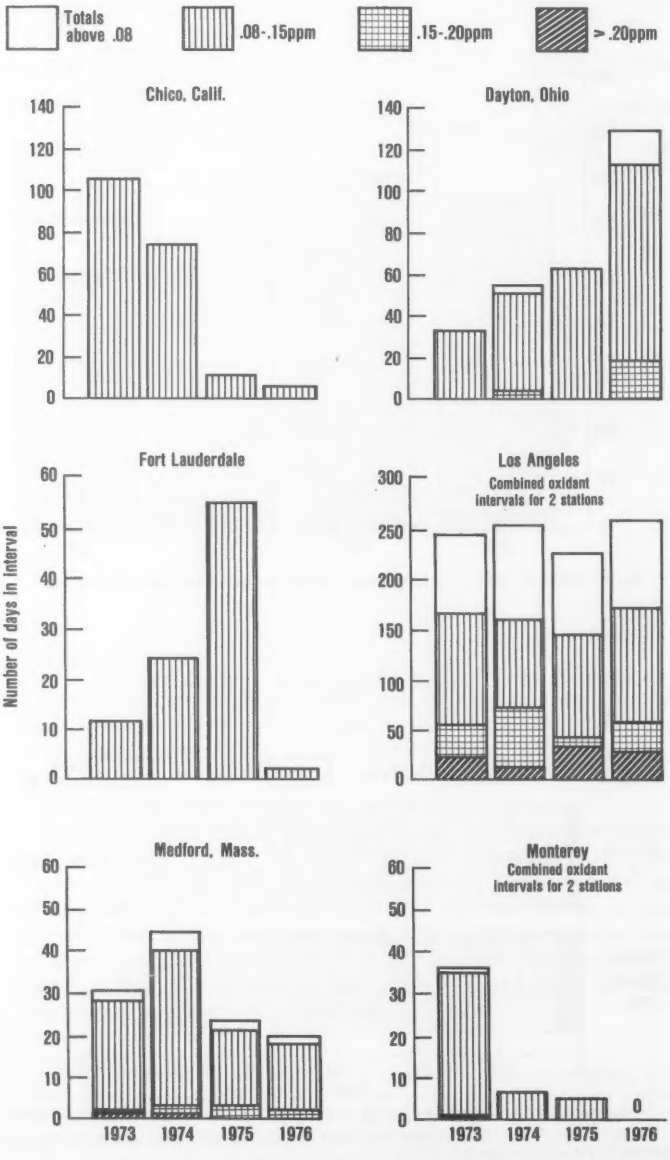
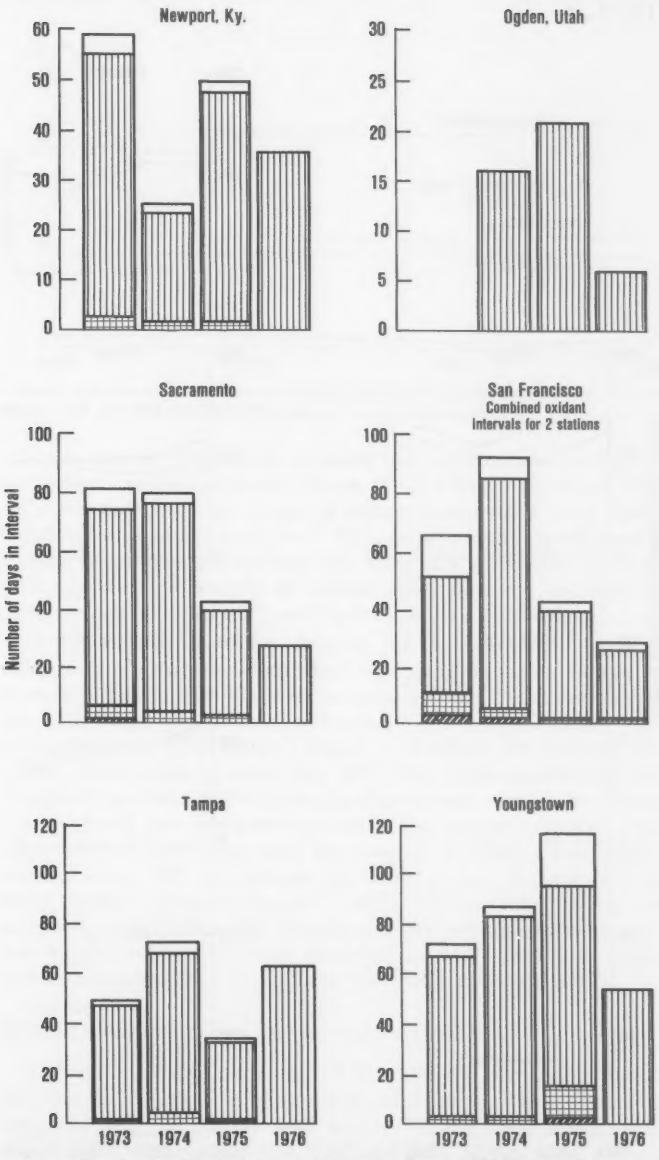


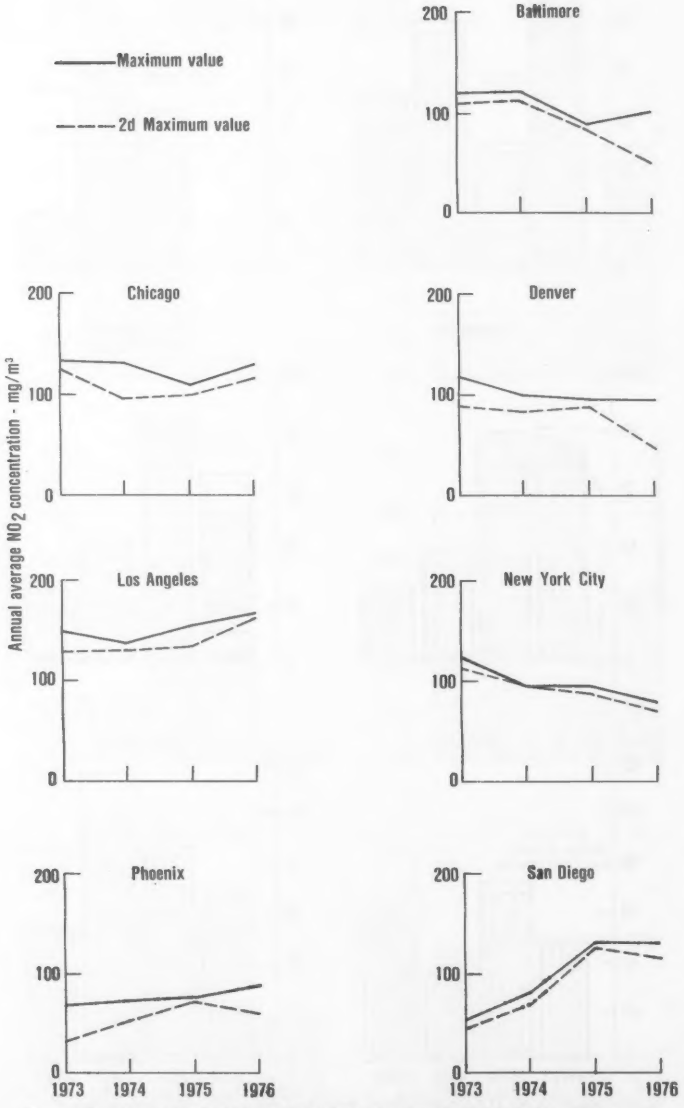
Figure 1-9 (continued)



Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-10

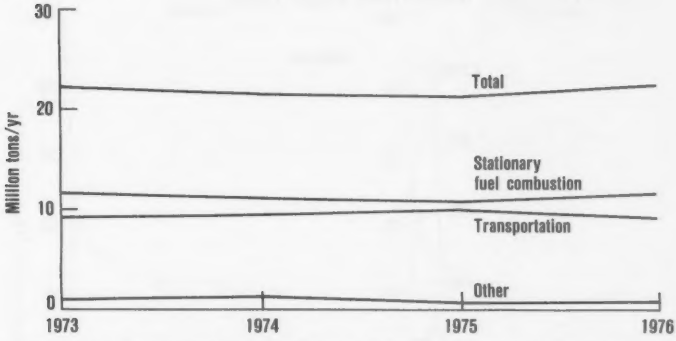
Trends in Annual Average NO_2 Levels, Seven Cities 1973-76



Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

Figure 1-11

Trends in National NO_X Emissions by Source Category 1973-76



Source: U.S. Environmental Protection Agency, *National Air Quality and Emissions Trends Report, 1976*, EPA-450/1-77-002 (Washington, D.C.: U.S. Government Printing Office, 1977).

These data on NO_2 levels correlate well with nationwide figures on nitrogen oxides emissions. Figure 1–11, which categorizes NO_x emissions, indicates little change in emissions over the 4 years, either individually by source or in total. NO_x emissions are almost equally divided between transportation and stationary combustion sources. With the implementation of stricter NO_x emissions controls on motor vehicles, a downward trend in NO_2 levels is expected.

With the exception of Los Angeles, the controls needed for most cities to attain the annual standard will probably suffice to meet a short-term standard if one is set between 500 and 1,000 micrograms per cubic meter per hour. (California's short-term standard is 470 micrograms per cubic meter.) Figure 1–12 shows the expected frequency distribution of short-term NO_2 data from monitoring sites in eight cities where problems may be encountered—where the annual average levels now approach or exceed the existing standard. Chicago, Denver, San Diego, and Los Angeles reported 1-hour observations above 500 micrograms per cubic meter. As annual NO_2 levels decrease through emission controls, 1-hour concentrations are expected to fall below 500 micrograms per cubic meter except in Los Angeles, where NO_2 levels exceeded the state's short-term standard an average of 23 days per year from 1973 through 1976.

Sulfur Dioxide and Total Suspended Particulates

The rationale for examining TSP and SO_2 air quality trends together is discussed in a footnote on page 6. The population-weighted maps in Figures 1–13 and 1–14 show areas which experience joint violations of the TSP and SO_2 annual and 24-hour standards, respectively. In many of the counties which are in viola-

Figure 1-12

Expected Annual Distributions of NO_2 Values above 200 Micrograms per Cubic Meter, 8 Cities, 9 Monitoring Sites 1973-76, Daily Maximum Hour Data

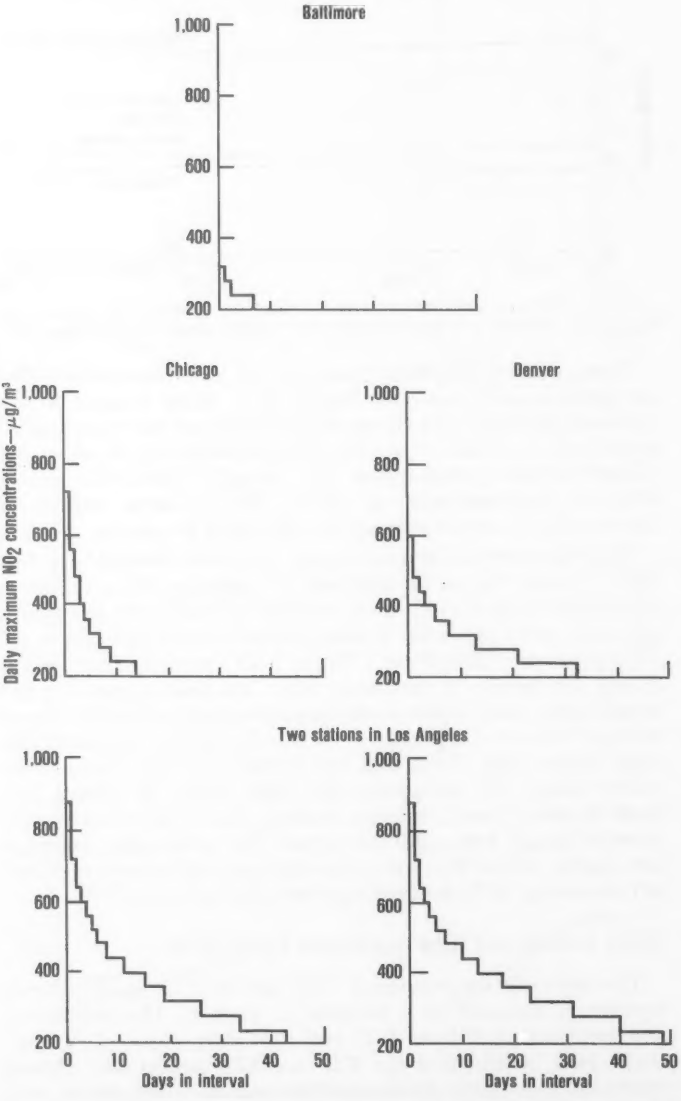
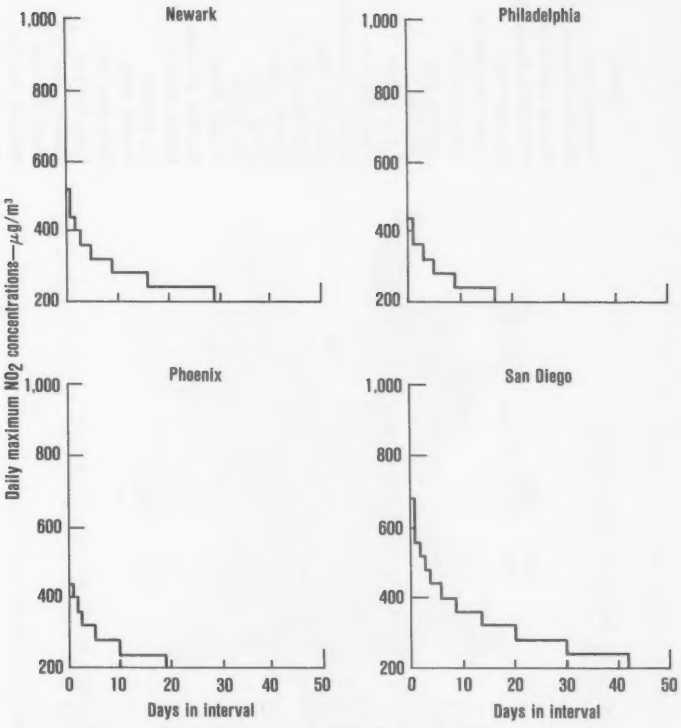


Figure 1-12 (continued)



Source: Based on the U.S. Environmental Protection Agency SAROAD data system.

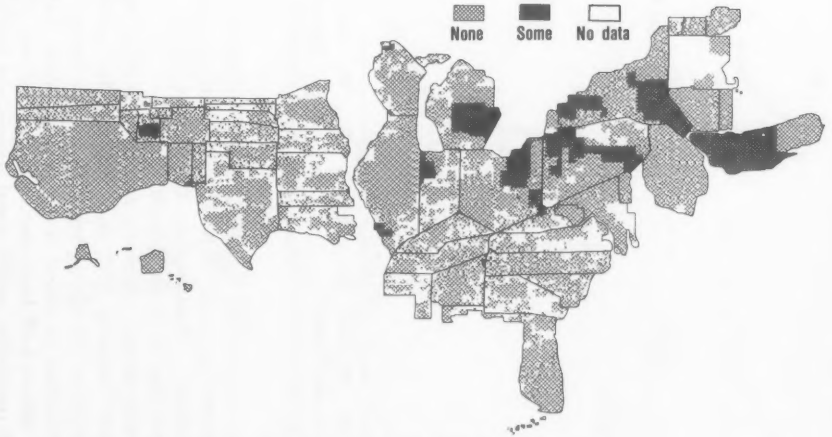
tion, copper smelters are located and populations are low. Several major metropolitan areas with large populations stand out: New York, Pittsburgh, Philadelphia, Cleveland, Detroit, Hammond, Indiana, and East St. Louis, Illinois.

The severity of such violations can be determined by comparing the measured levels of TSP and SO_2 and the number of joint violations with the NAAQS. These data are also shown in the figures.

The distribution of excess levels of TSP alone (not associated with SO_2) reflects both local sources, such as cement plants, asphalt plants, and steel mills, and regional sources—in the West, fugitive or windblown dust from agricultural sources and in the East sulfates from a heavy concentration of coal-burning powerplants. Figure 1–15 shows counties with violations of the TSP annual standard as reported by stations with the *second* poorest level recorded in

Figure 1-13

Concurrent Violations of TSP and SO_2 Annual Standards, by County 1975[1]



[1]The standard for TSP is 260 milligrams per cubic meter; for SO_2, 365 milligrams per cubic meter.

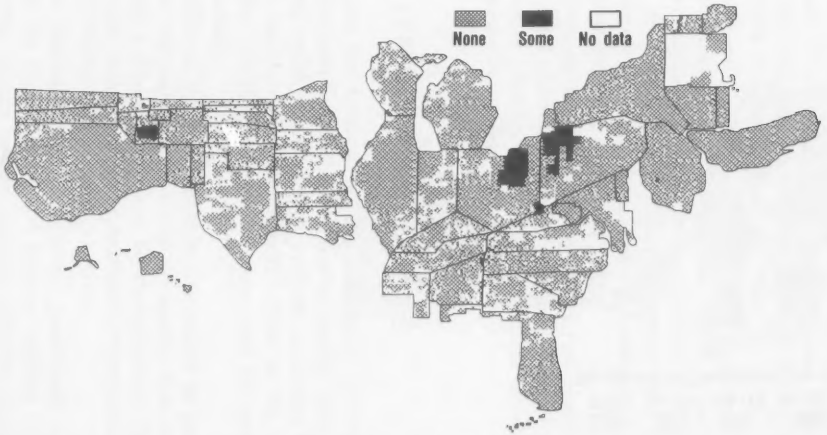
[2]Monitors near copper smelters.

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

County	Stations in violation
Cuyahoga, Ohio	9
Allegheny, Pennsylvania	4
Hancock, West Virginia	4
Philadelphia, Pennsylvania	3
Erie, New York	2
Brooke, West Virginia	2
Jackson, Alabama	2
Jefferson, Ohio	2
Lahe, Ohio	2
Salt Lake, Utah[2]	2
Albany, New York	1
Marshall, West Virginia	1
Columbiana, Ohio	1
Coshocton, Ohio	1
Mahoning, Ohio	1
Monroe, Ohio	1
Lake, Indiana	1
Madison, Illinois	1
Marathon, Wisconsin	1
Cochise, Arizona[2]	1
Gila, Arizona[2]	1
Bannock, Idaho	1
Bronx, New York	1
Kings, New York	1
Manhattan, New York	1
Queens, New York	1
Richmond, New York	1
Wayne, Michigan	1

Figure 1-14

Concurrent Violations of TSP and SO_2 Daily Standards, by County 1975[1]



County	Stations in violation
Salt Lake, Utah[2]	16
Allegheny, Pennsylvania	1
Brooke, West Virginia	2
Hancock, Washington	2
Cuyahoga, Ohio	2
Jefferson, Ohio	2
Bannock, Idaho	2
Gila, Arizona[2]	1
Jackson, Alabama	3

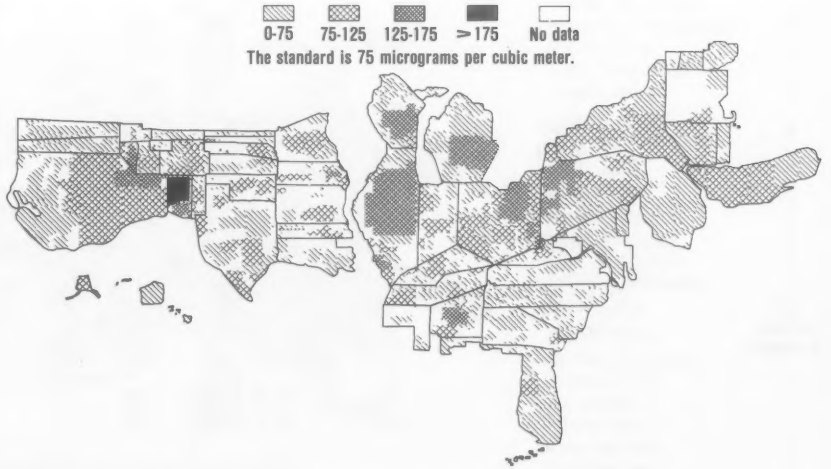
[1]The standard for TSP is 75 milligrams per cubic meter; for SO_2, 80 milligrams per meter.

[2]Monitors near copper smelters.

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

Figure 1-15

National Exposure to TSP by County, Population Adjusted 1973-75



[1]The second maximum annual geometric mean per county is used.

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

the county. (The worst station is usually influenced more by local sources, and the second poorest is probably more indicative of countywide problems.) Counties with high TSP levels in the East are likely to be affected by transport of sulfates from the powerplant corridor that runs northeast from Ohio. The trend in violations of both TSP and SO_2 standards has been steadily downward, as reported in the CEQ Seventh Annual Report [27] and by EPA,[28] although many areas continue to violate ambient standards.

NONCRITERIA POLLUTANTS

Figure 1–16 is a population-weighted map of sulfate levels by county. There is no ambient air quality standard for sulfates, but it is clear from this map that higher levels of sulfate aerosols are found in densely populated areas.

Figures 1–17 and 1–18 show the nationwide patterns of population exposures to nitrates and benzo-a-pyrene, which is an indicator of potential carcinogenesis. Criteria for health effects of these pollutants are not yet developed. It should be noted that data for benzo-a-pyrene are scanty for many areas where a significant proportion of the U.S. population lives.

These pollutants are all related to fossil fuel combustion, predominantly from stationary sources. However, some of the nitrates are a product of photochemical ozone formation which is a result of NO_x emissions from motor vehicles.

HEALTH EFFECTS RISK ANALYSIS

For 2 years the Council on Environmental Quality has been developing methods for relating ambient air quality data, population statistics, and health impacts. A generalized model has been developed which calculates population health risks on the census tract level using the UPGRADE computer system and Harvard's SYMAP mapping package.

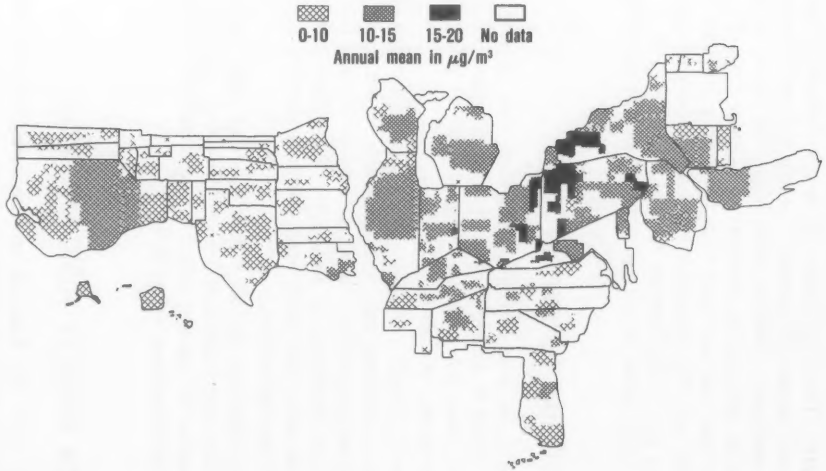
The flexibility of the model enables the analyst to make risk calculations for any pollutant for which air quality data are available and for which a damage curve can be approximated. The mapping system provides both visual and quantitative representations of risk in Standard Metropolitan Statistical Areas.

In the last Annual Report we reported preliminary results of the risk analysis for Los Angeles and Denver relating CO levels to angina pectoris attacks among patients suffering from this heart disease.[29]

Detailed analysis of CO effects on angina patients is now complete for nine cities. Their population densities and expected annual angina attack rates are shown in Figure 1–19. The expected number

Figure 1-16

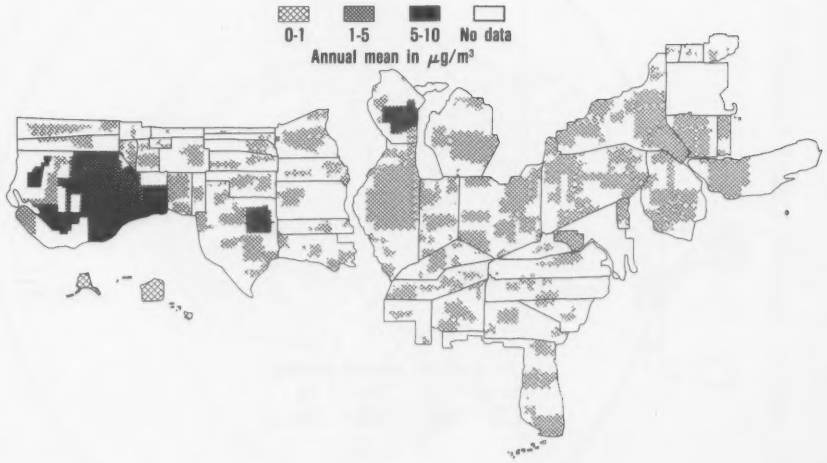
National Exposure to Sulfates by County, Population Adjusted 1973-75



Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

Figure 1-17

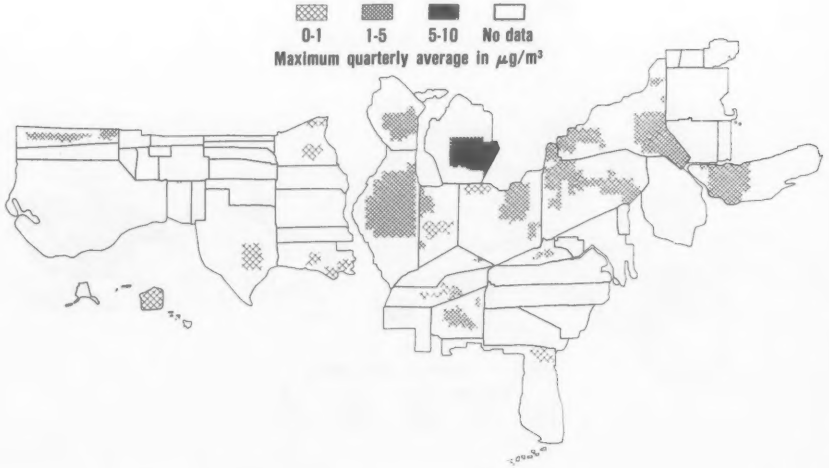
National Exposure to Nitrates by County, Population Adjusted 1973-75



Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

Figure 1-18

National Exposure to Benzo-a-Pyrene by County, Population Adjusted 1973-75



Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

Figure 1-19

Risks of CO-Related Angina Attacks[1], 9 Cities 1975

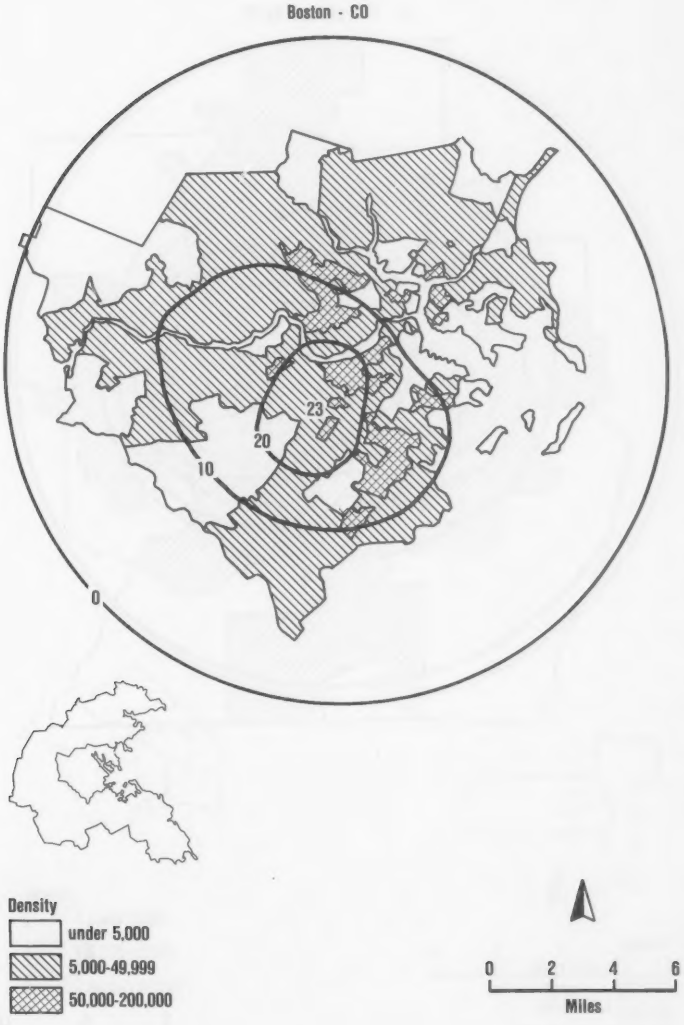


Figure 1-19 (continued)

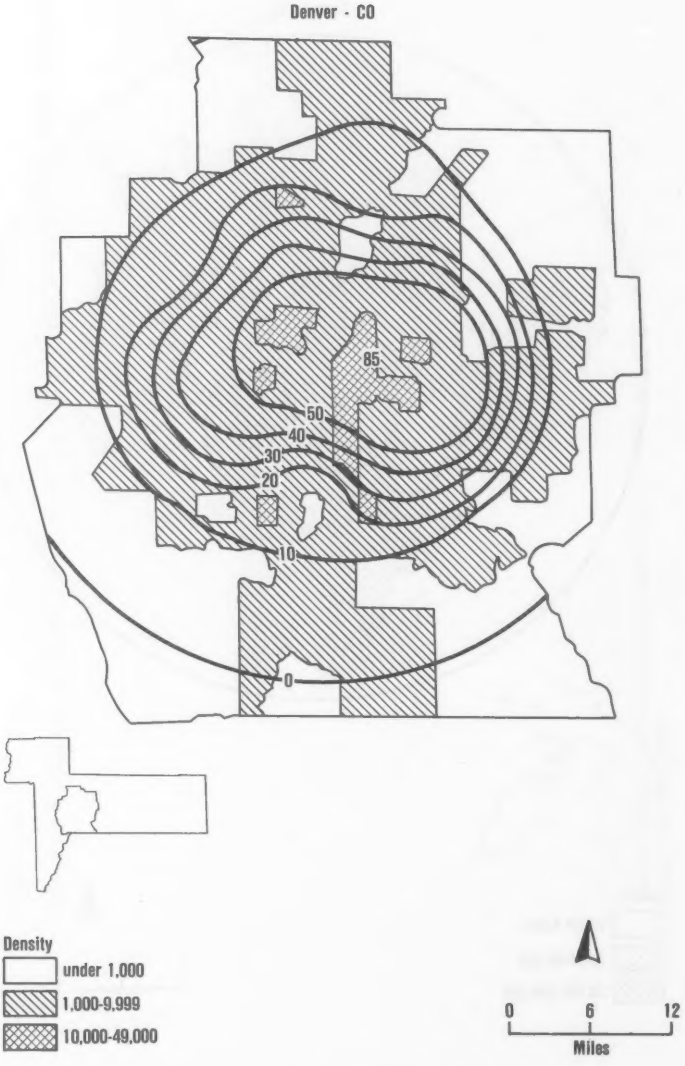


Figure 1-19 (continued)

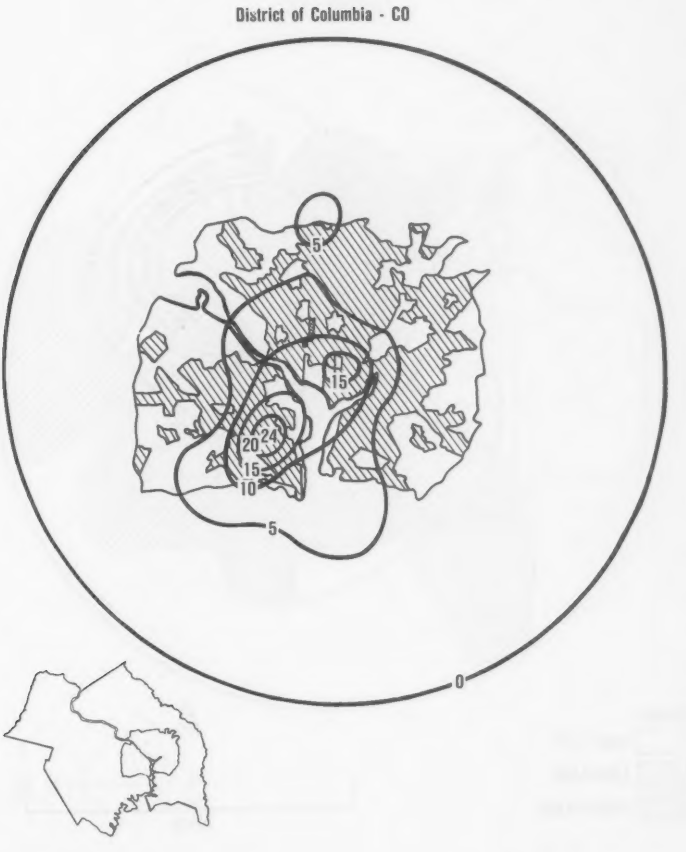


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Figure 1-19 (continued)

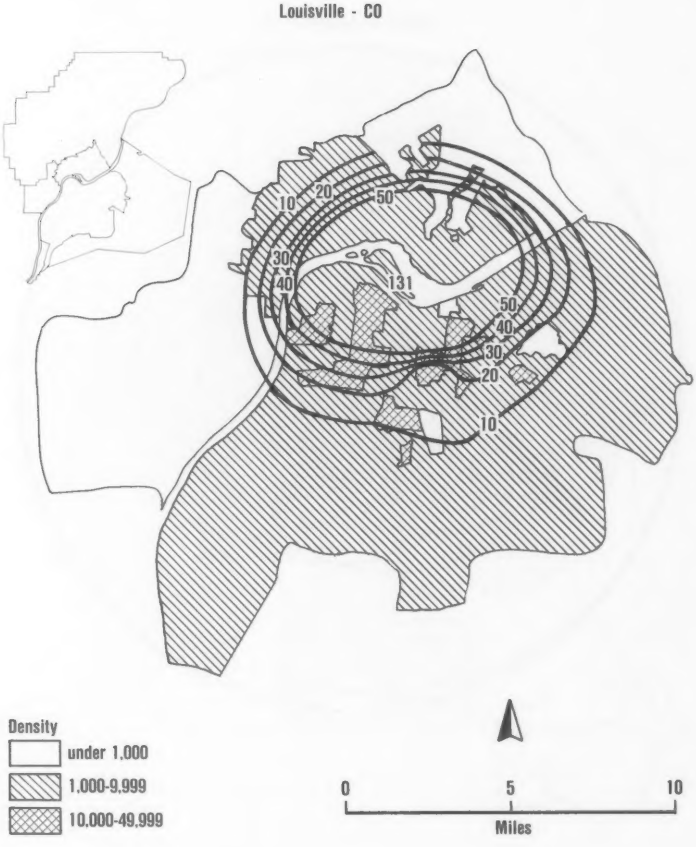


Figure 1-19 (continued)

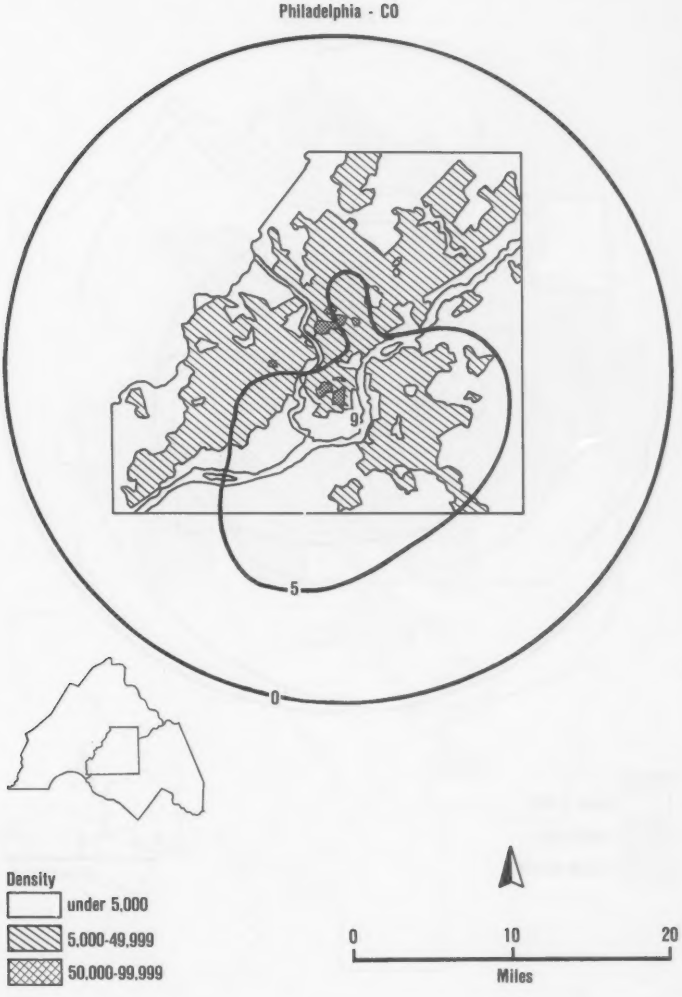


Figure 1-19 (continued)

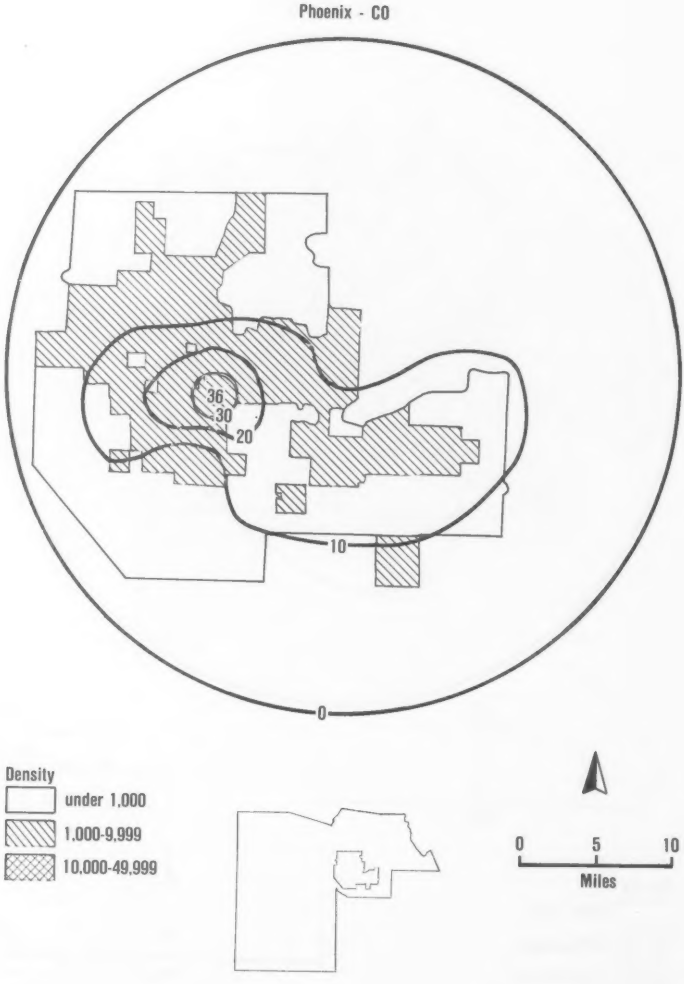


Figure 1-19 (continued)

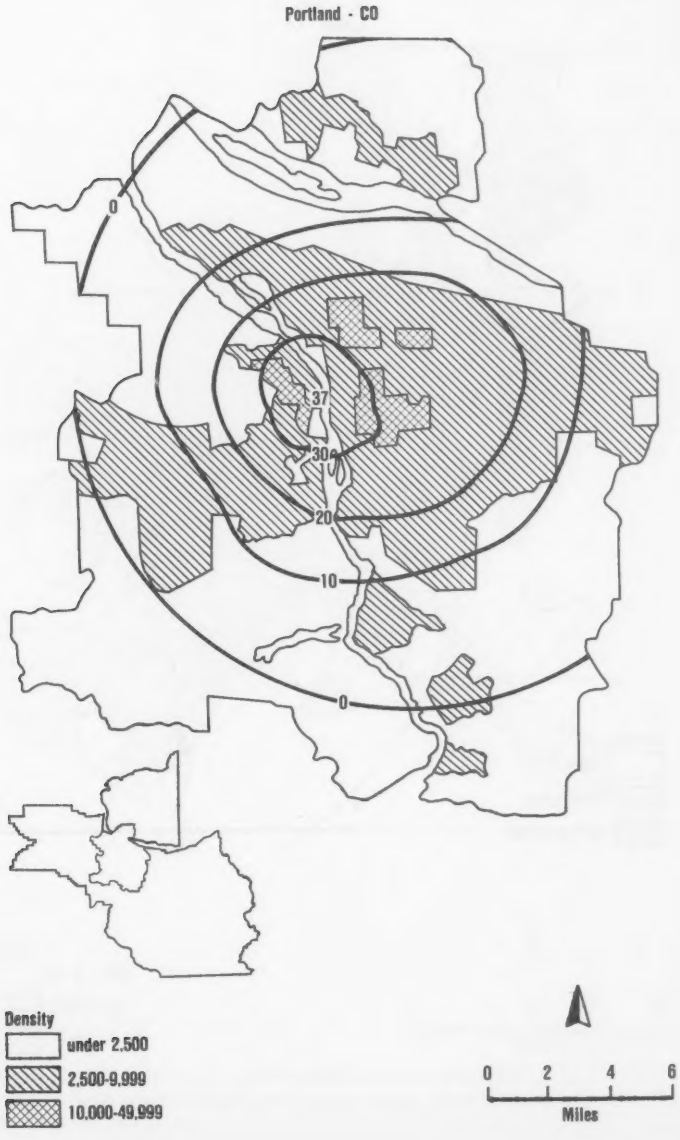
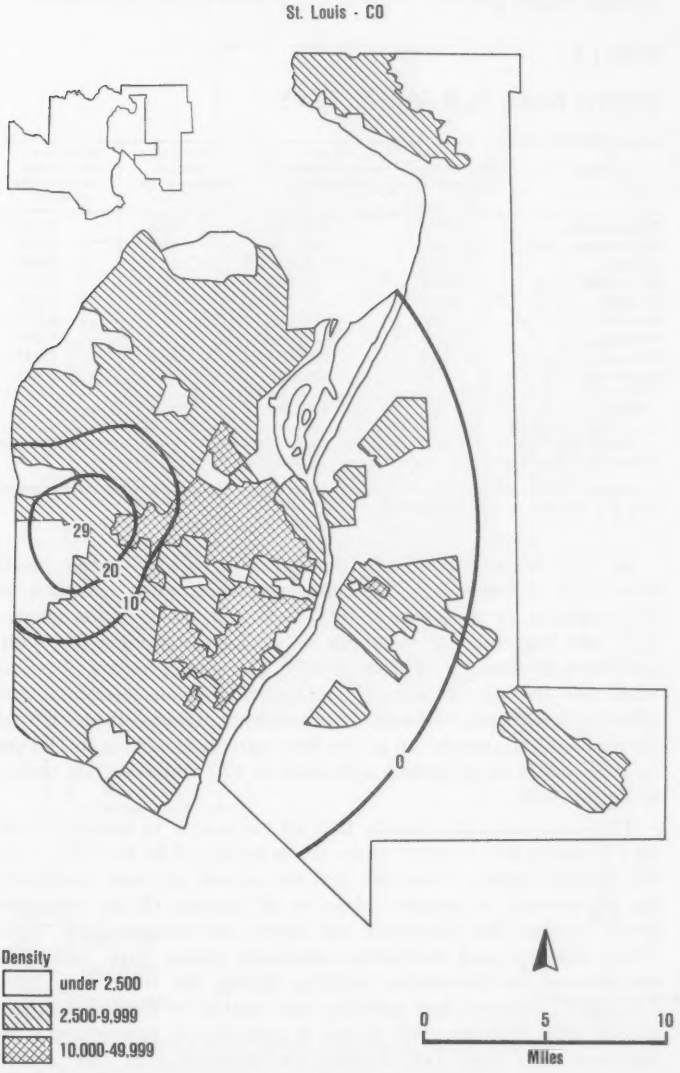


Figure 1-19

Seattle - CO
26
20
10
0
Density
under 2,500
2,500-9,999
10,000-49,999
0
5
10
Miles

Figure 1-19 (continued)



[1]A figure on an isopleth is the number of attacks per thousand per year.

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

of angina attacks caused by CO exposure is 126,400 (see Table 1–1), compared to an estimated 413 million attacks from all causes. This figure is based on the assumption that each angina patient suffers an average of 3 attacks per day and that on a national average angina patients comprise 2.1 percent of the population.

Table 1-1

Angina Risks in 9 SMSAs 1975

City	Population (thousands)	Total annual attacks[1] (thousands)	CO-related attacks (thousands)	CO-related attacks as percentage of total
Philadelphia	4,816	111,000	16.0	0.014
Washington, D.C.	2,860	65,800	13.7	0.021
Boston	2,753	63,300	15.7	0.025
St. Louis	2,362	54,300	8.3	0.015
Seattle	1,421	32,700	2.2	0.007
Denver	1,227	28,200	34.3	0.122
Portland	1,006	23,100	11.9	0.052
Phoenix	936	21,500	9.2	0.043
Louisville	826	19,000	15.1	0.079
Total		413,000	126.4	

[1] Assuming that angina patients make up 2.1 percent of the population, average three attacks per day, and are uniformly distributed in the population.

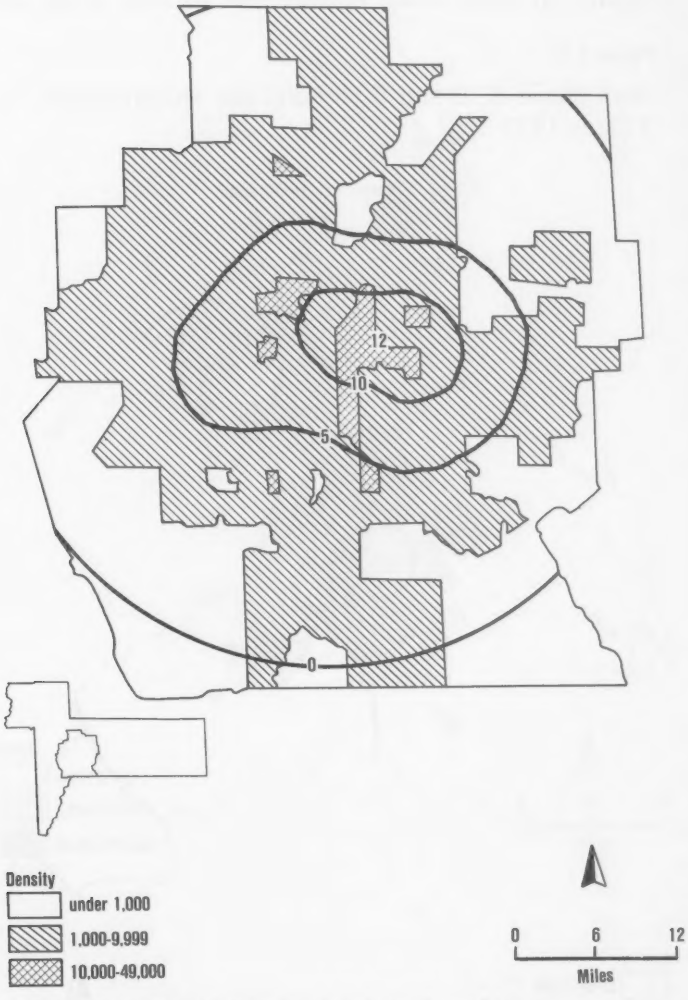
Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

As levels of air pollutants improve, health risks will lessen much more than proportionally. As discussed earlier, when emissions of CO, oxidants, or any other pollutant are reduced, both the magnitude and frequency of violations of ambient standards for those pollutants decrease much more rapidly. The spatial impact of pollutants also decreases at a rapid rate when emissions decrease, thus affecting fewer people as well. Improvements expected in the spatial distribution and population at risk from carbon monoxide in Denver in 1985, based on projected reductions in CO emissions, are shown in Figure 1–20.

These estimates also assume that all the people in areas polluted by CO are in fact exposed to the levels measured by the CO monitor. Several studies [30] indicate that the actual exposure (weighted for population) is probably closer to 60 percent of the measured levels, so that the tabulated risk levels are conservatively high. These analyses used residential population census data, which do not account for population mobility during the work day. Only two cities contacted had mobility data usable by the CEQ model at this time, but the 1980 census is expected to supply them. In analyzing data from Los Angeles, we estimated that 138 percent more people are in downtown LA during working hours than the census data indicated. For CO, then, our best estimate is a balance between these two factors.

Figure 1-20

Projected Risks of CO-Related Angina Attacks[1], Denver 1985



[1]A figure on a isopleth is the number of attacks per thousand per year.

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

Risk mapping for photochemical oxidants is more complicated than for CO. The health effects of oxidants are numerous, and they affect everyone although in different ways and degrees. Further, oxidant pollution (measured by violations of a pre-set ozone level) is far more widespread, putting large numbers of people at risk. CEQ analyzed oxidant risks by person-days and degree of severity. Figure 1–21 shows oxidant exposure levels for seven of the nine

Figure 1-21

Days above 0.10 and 0.15 Parts per Million Ozone, 7 Cities 1975

Figure 1-21 (continued)

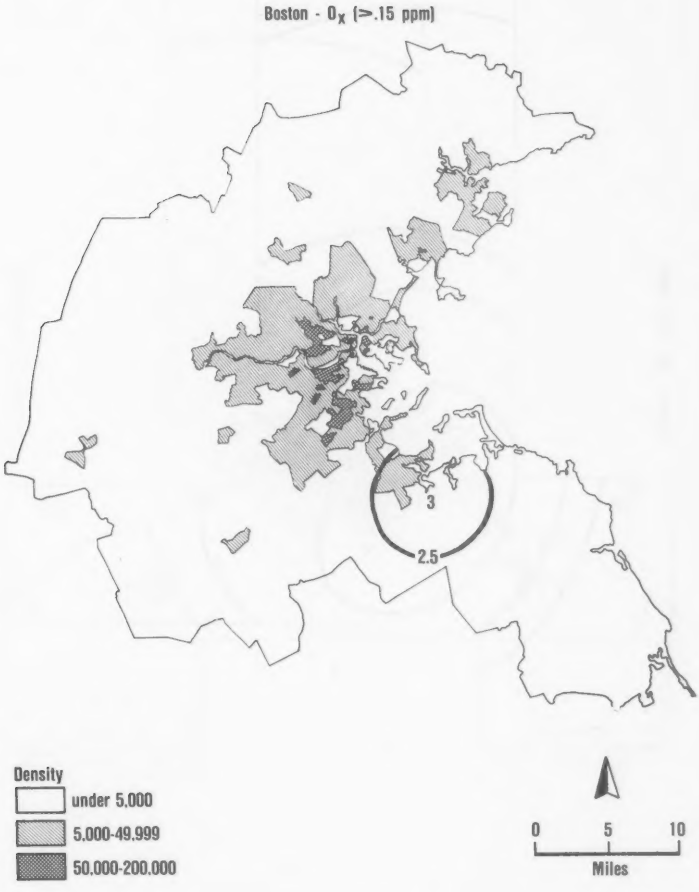


Figure 1-21 (continued)

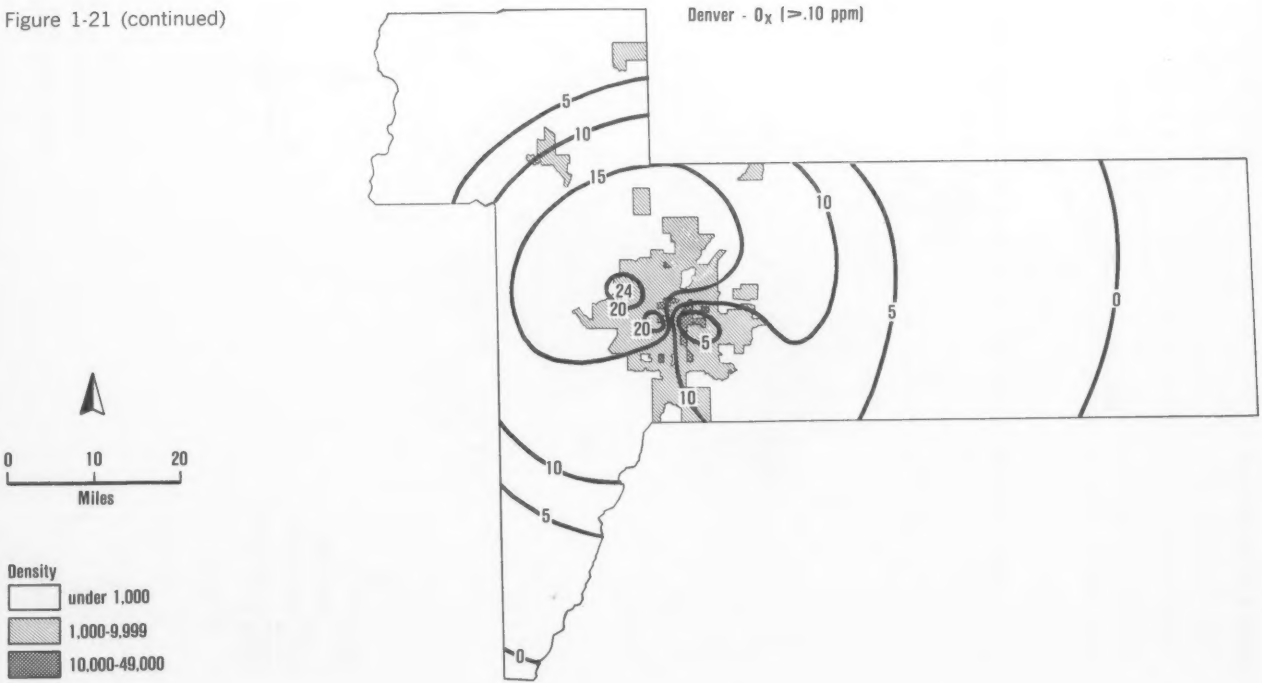


Figure 1-21 (continued)

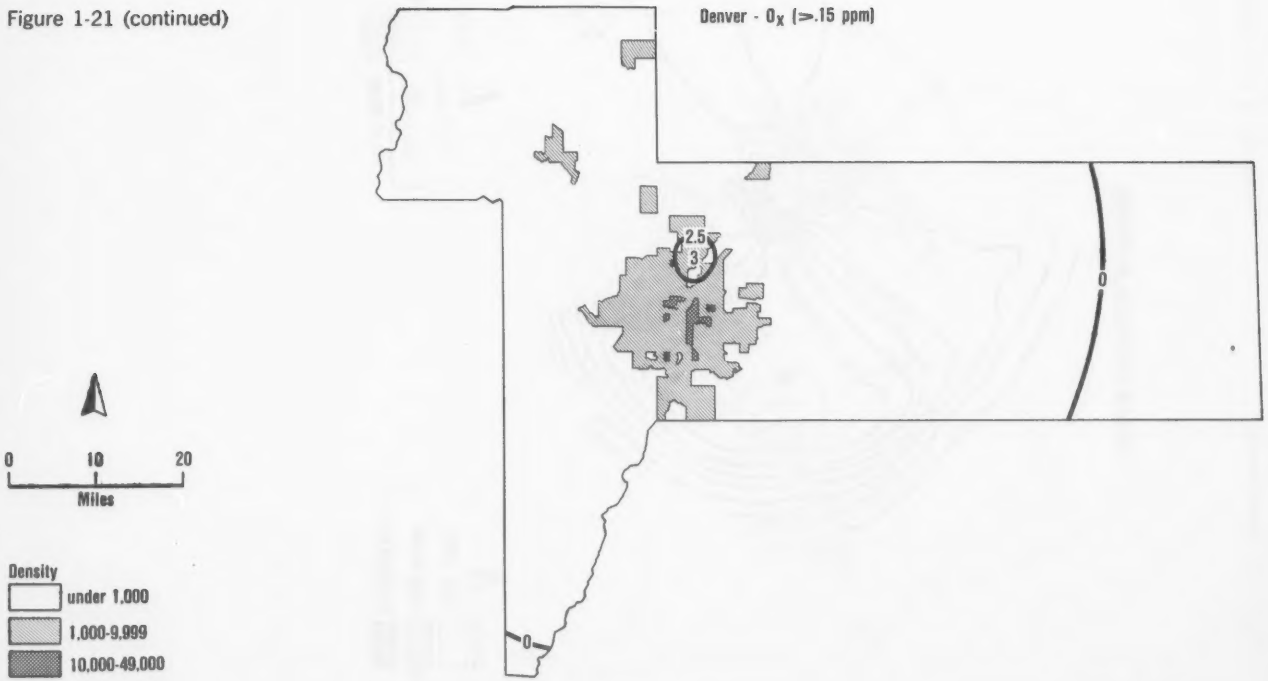


Figure 1-21 (continued)

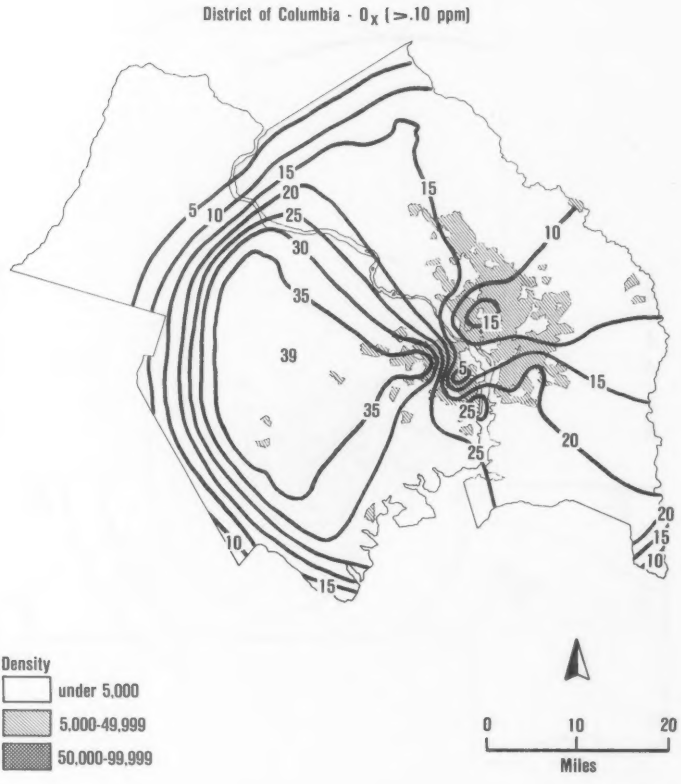


Figure 1-21 (continued)

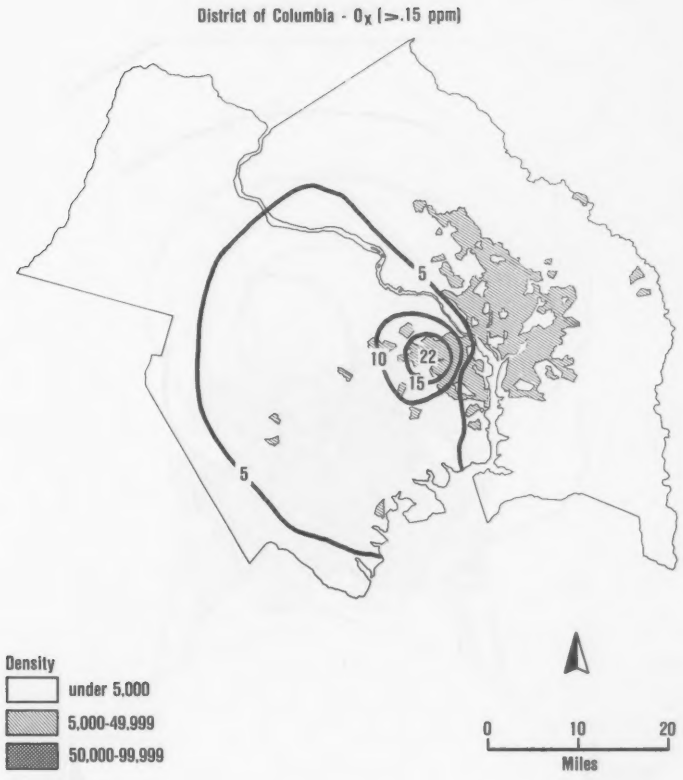


Figure 1-21 (continued)

Figure 1-21 (continued)

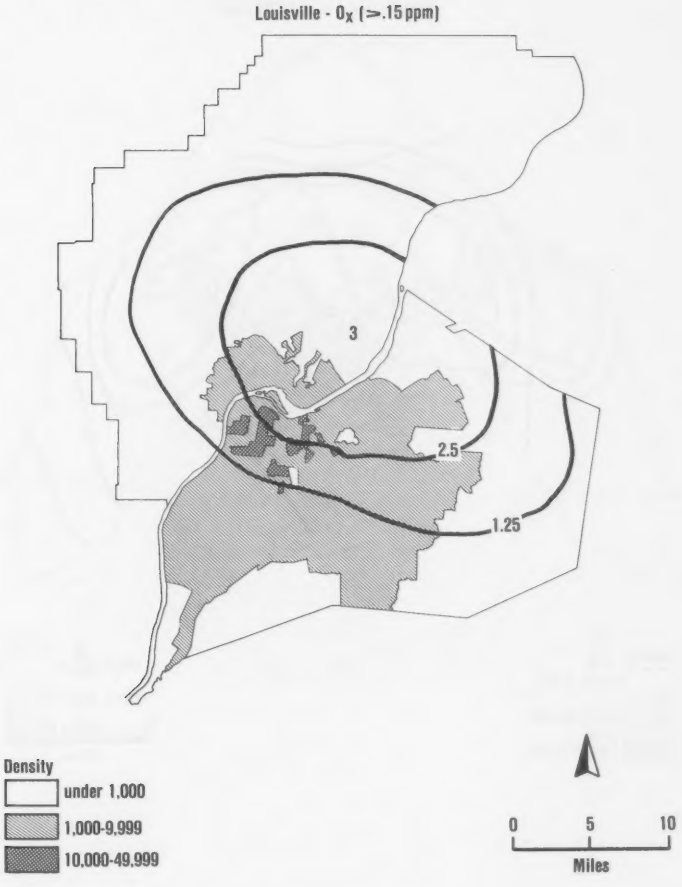


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Figure 1-21 (continued)

Figure 1-21 (continued)

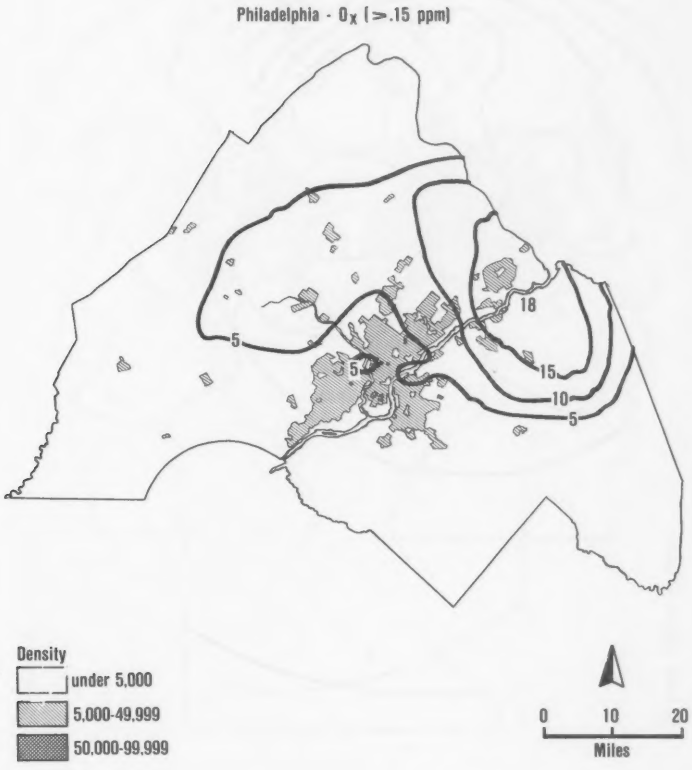


Figure 1-21 (continued)

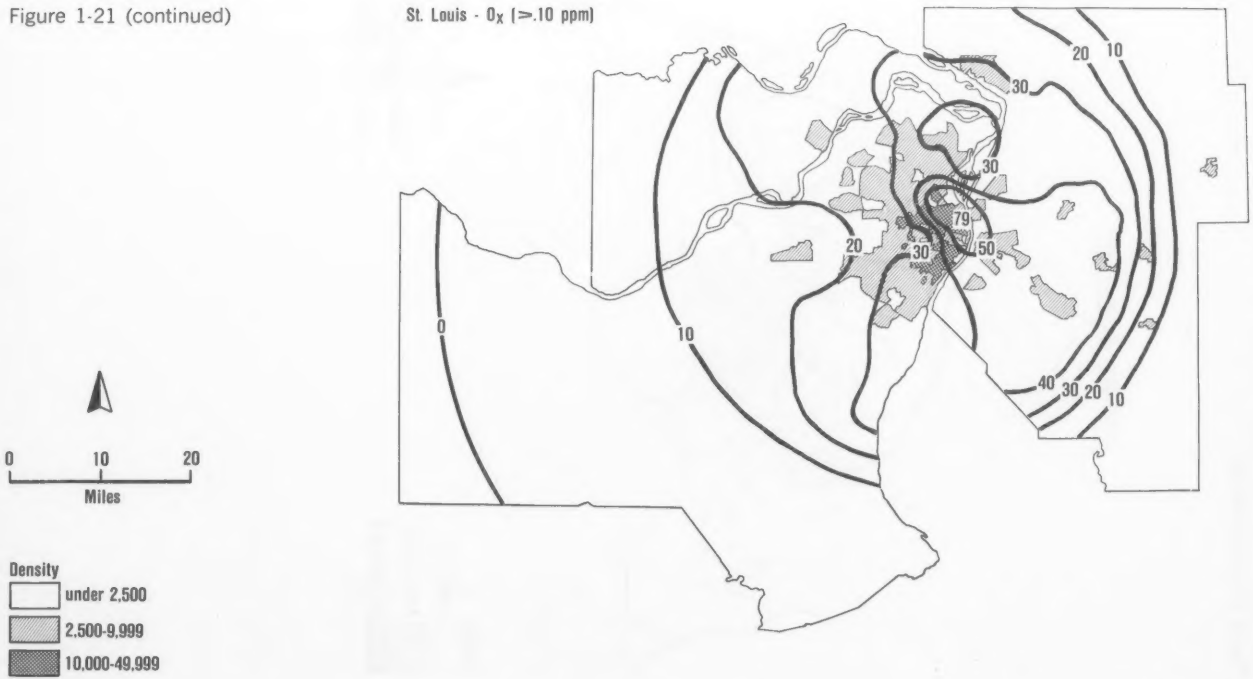


Figure 1-21 (continued)

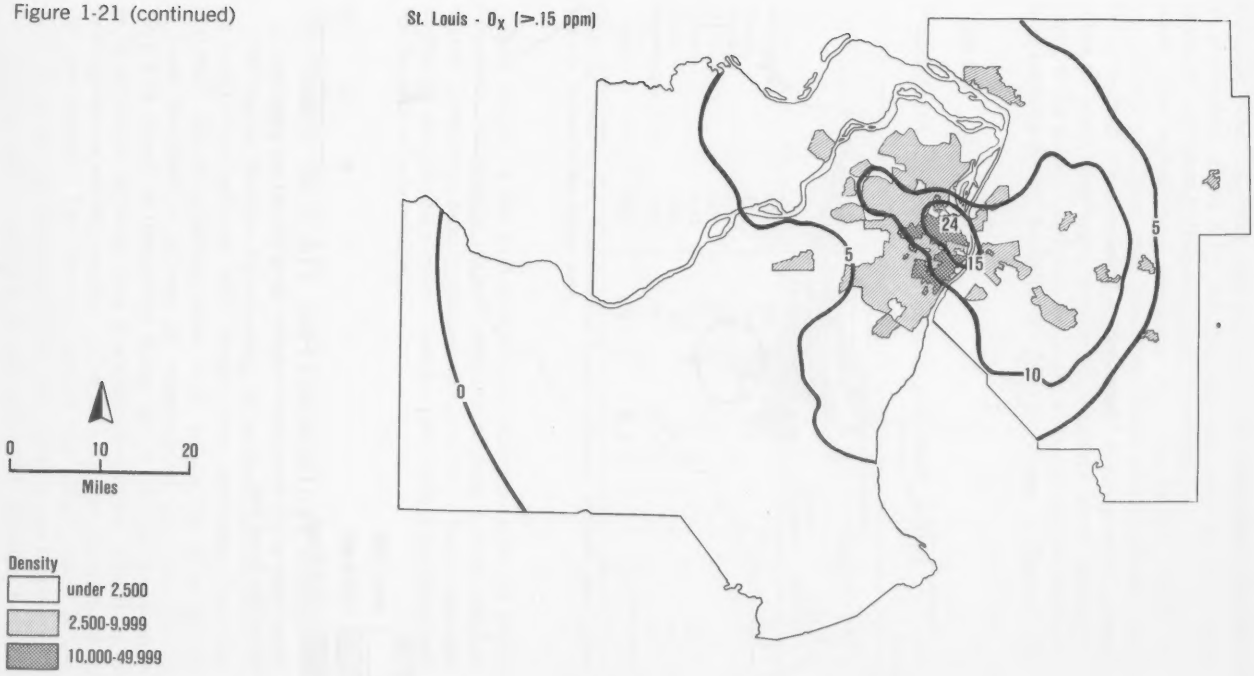


Figure 1-21 (continued)

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

cities for which CO risks were analyzed. Table 1–2 lists the number of person-days above 0.10 and 0.15 for each city. In every city, exposure is greatest in frequency and magnitude away from the city center. The highest ozone exposures are in the suburbs, which are less densely populated than downtown areas. Computations which factor in both the degree of exposure and the population density therefore show maximum population exposure levels somewhere between the suburbs and the city center. Projected population exposure isopleths for Philadelphia in 1987 are shown in Figure 1–22.

Table 1-2

Population Exposure to Ozone in Seven Cities

City	Population (millions)	Person-days (millions)			
		1975		1987	
		Above 0.10 ppm	Above 0.15 ppm	Above 0.10 ppm	Above 0.15 ppm
Philadelphia	4.82	96.6	24.8	14.8	11.9
Denver	1.23	14.7	0.8	0	0
Portland	1.00	3.2	0	—	—
St. Louis	2.36	81.2	23.2	—	—
Boston	2.75	21.0	2.3	—	—
Louisville	0.83	9.7	1.8	—	—
Washington, D.C.	2.80	48.7	13.8	—	—
Total	15.86	275.1	66.7		

Source: Based on U.S. Environmental Protection Agency SAROAD data system and U.S. Bureau of the Census data.

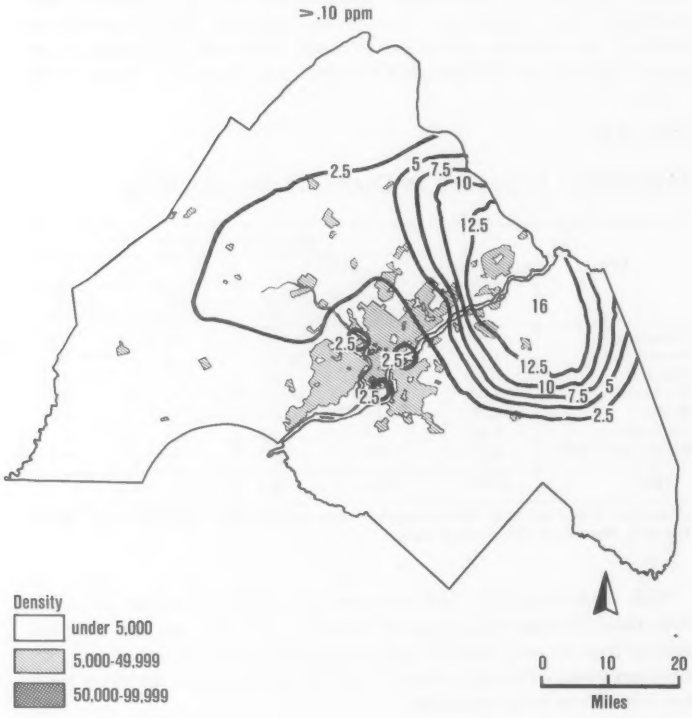
Risk analysis of this kind improves our ability to assess air pollution risks. Incremental costs of emission controls can be weighed against incremental gains in terms of specific health effects or reduced exposure risks, offering a clearer basis for public policy decisions than has heretofore been available.

REVISIONS IN STATE IMPLEMENTATION PLANS

The original deadline for achieving the national primary ambient air quality standards was 1975, except where extensions had been granted.[31] Strictly speaking, states could not legally allow growth in areas that failed to achieve the standards by that date. But in 1976 EPA issued an interpretive ruling which allowed new sources to be located in polluted areas if additional emission reductions in existing sources would more than offset the projected emissions from the new sources.[32] The Congress adopted this "offset policy" in the 1977 Clean Air Act Amendments but also imposed new requirements for making further progress toward attaining national ambient standards.[33]

Figure 1-22

Projected Days above 0.10 and 0.15 Parts per Million Ozone, Philadelphia 1987

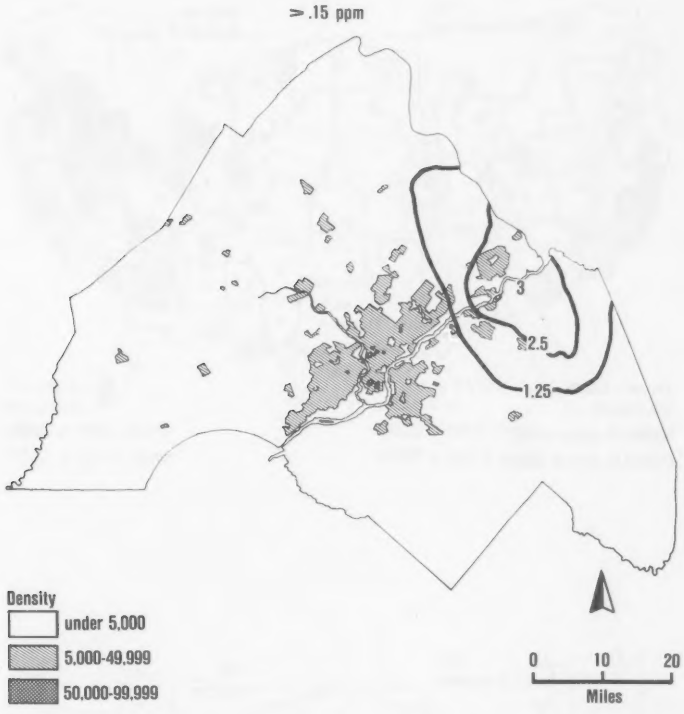


ATTAINMENT STATUS

The first requirement was for states to report by December 7, 1977, on which regions or subregions had or had not met national standards as of August 1977 (when the 1977 Amendments were passed).[34] Attainment status, as reported by the states and approved by EPA, on each major pollutant for which national ambient standards exist—photochemical oxidants, carbon monoxide, sulfur dioxide, total suspended particulates, and nitrogen dioxide—is shown in Figure 1–23.

The states could use different geographic units in their reporting because some pollutants—such as photochemical oxidants—disperse widely and others—such as carbon monoxide—are largely confined to downtown areas. The boundaries of the nonattainment areas

Figure 1-22 (continued)



were generally drawn to include the actual area where ambient violations of the NAAQS were occurring. The designations were meant to provide a starting point for states in their efforts to correct existing air quality problems. States may adopt control measures over a broader or narrower geographic area than the nonattainment area for reasons of equity or simplicity of administration or to allow more growth in clean areas. The basic requirement is that sufficient controls be placed on those sources, wherever they are located, that contribute to the modeled or monitored ambient violations in order to provide for attainment by the required deadline.

The most widely violated ambient air quality standard continues to be the oxidant standard. Of 105 urban areas in the United States with populations of more than 200,000, only Honolulu has recorded eight consecutive quarters without a violation, the criterion for

Figure 1-23

Nonattainment of Criteria Pollutants, August 1977[1]

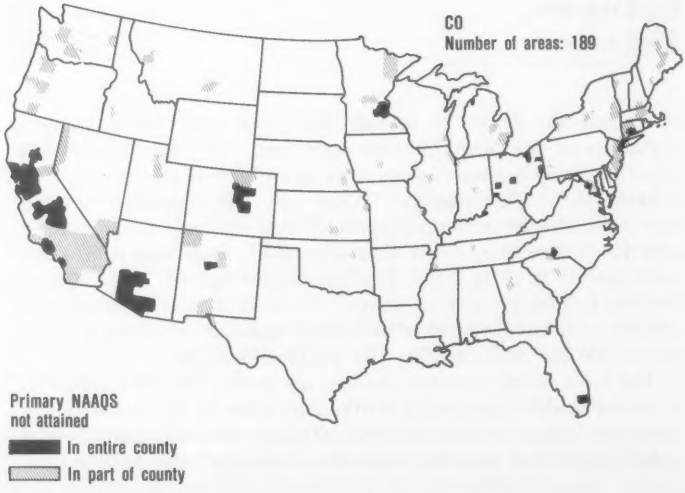
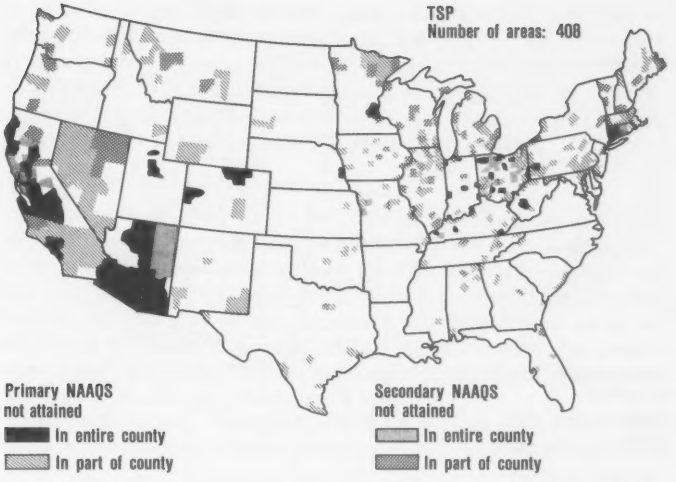


Figure 1-23 (continued)



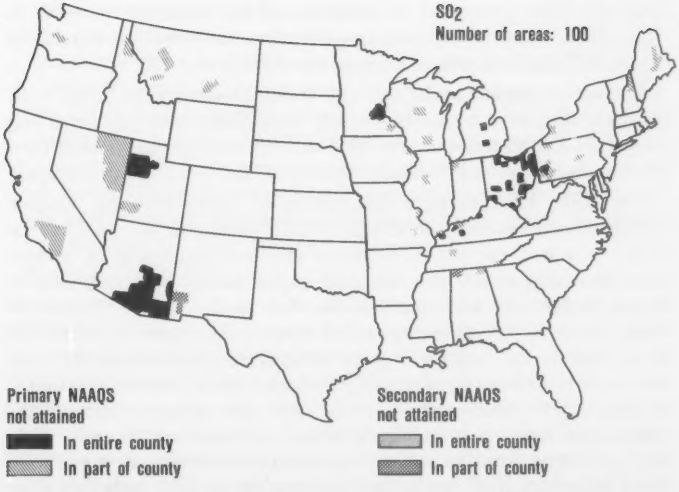
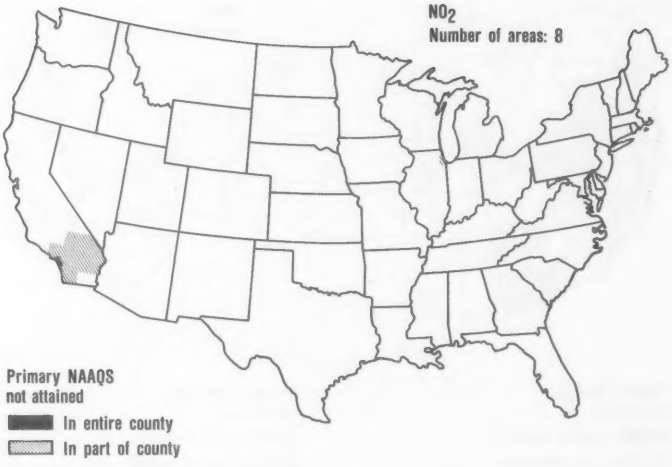


Figure 1-23 (continued)



[1]In whole or in part.

Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

attainment designation. Spokane is unclassifiable because sufficient monitoring data are not available to permit classification. Of the remaining 103 urban areas, the record shows that 97 are in violation of the primary oxidant standard; the other 6 do not have monitoring data but were presumed in violation of the standard because of similarities to the 97 where data exist; these areas will be monitored in the 1978 oxidant season (summer and fall).[35]

Carbon monoxide violations are worse in downtown areas with heavy traffic, so EPA accepts small downtown areas as reporting units for CO. State reports to EPA on CO attainment showed continuing violations in 189 urban counties or parts of urban counties.[36]

For TSP, EPA permits designation of units that are smaller than a county because the effects of TSP violations are likely to be local. As noted earlier, EPA policy allows designations of attainment to be approved in rural areas experiencing TSP violations if it can be demonstrated that fugitive dust is the cause.[37] Priority is being given to the development of control programs in urbanized areas because the fugitive dust in these areas characteristically contains a combination of industrial pollutants from a number of sources, making it potentially more harmful than the normally uncontaminated rural fugitive dust. "Rural areas" were defined as those with low population densities and without industrial development or significant industrial TSP emissions. State reports to EPA indicated that

all or parts of 408 counties were nonattainment areas in violation of TSP standards.

Nonattainment areas for SO_2 are limited to a few parts of the country; for NO_2, even more so. The metal smelting regions of southern Arizona and to a lesser degree of Nevada and Utah are in violation of the SO_2 standard; other nonattainment areas are in the north-central regions where use of high sulfur midwestern coal by powerplants is heavy. Altogether, 100 counties or parts of counties reported SO_2 violations. For NO_2, nonattainment is concentrated almost entirely in southern California, Denver, and Chicago, with 8 counties or parts of counties reporting violations.[38]

NONATTAINMENT AREAS

The second requirement of the 1977 Amendments in achieving national ambient standards is for each state to revise its State Implementation Plan (SIP) to show how it will bring nonattaining areas into compliance by the end of 1982. For the automobile-related pollutants, oxidants and carbon monoxide, states may have up to an additional 5 years, to the end of 1987, if they show EPA that attainment is not possible by 1982. Many states with oxidant violations are expected to request the additional 5 years.

SIP revisions are to be filed with EPA by January 1, 1979. For nonattainment areas, revisions must contain at least these elements:

- A "comprehensive, accurate, current inventory of actual emissions" and methods to identify and quantify estimated emissions from major new sources
- A definition of the geographic areas for which control strategies are or will be developed and a determination of how much control is needed to attain standards by 1982, allowing for growth
- Imposition of "reasonably available control technology" on existing sources which must be controlled
- New permit requirements for major new sources, including compliance by the source with the "lowest achievable emission rate," compliance with applicable air pollution control requirements by all other major sources owned by the same company, and a determination by the state that the new source can be built without interfering with progress toward attaining the standard
- A demonstration showing how "reasonable further progress" will be made annually in reducing emissions so that the 1982 or, where appropriate, the 1987 deadline can be met.[39]

If a state wants the additional time beyond 1982 to attain the carbon monoxide or the oxidant standard, the revised Plan must include consideration of a program for regularly inspecting automobile emission control systems and for requiring their proper maintenance. States have the added option of adopting the stricter California auto emission standards for cars sold within their boundaries. The Amendments thus permit states to reduce hydrocarbon and carbon monoxide emissions from automobiles more than federal standards require. Table 1–3 lists types of stationary sources of emissions for which EPA

Table 1-3

Stationary Sources of Volatile Organic Compounds, August 1978

(thousand metric tons per year)

Source category	Nationwide emissions[1]
Petroleum refinery fugitive emissions (leaks)	150
Surface coating of miscellaneous metal parts and products	200
Vegetable oil processing	70
Factory surface coating of flatwood paneling	50
Large appliance manufacture	35
Magnet wire insulation	10
Gasoline bulk plants	150
Metal furniture manufacture	100
Petroleum liquid storage, fixed roof tanks	700
Degreasing	700
Bulk gasoline terminals	250
Petroleum refinery vacuum systems, waste water separators and process unit turnarounds	700
Cutback asphalt paving	700
Surface coating of automobiles, cans, metal coils, paper, and fabric products	900
Service stations, Stage I	400
Pharmaceutical manufacture	50
Rubber products manufacture	150
Graphic arts (printing)	400
Service stations, Stage II	500
Petroleum liquid storage, floating roof tanks	150
Organic chemical manufacture	
Process streams	450
Fugitive (leaks)	600
Dry cleaning	250
Architectural and miscellaneous coatings	300
Ship and barge transport of gasoline and crude oil	60
Wood furniture manufacture	200
Organic chemical manufacture	
Waste disposal	150
Storage and handling	300
Natural gas and crude oil production	200
Natural gas and natural gasoline plants	150
Adhesives	200
Other industrial surface coatings	300
Auto refinishing	150
Other solvent usage	3,000
Metals manufacture Other manufacturing Fuel combustion Forest, agricultural, and other open burning Solid waste disposal	4,000
Total stationary sources	16,700,000
Total transportation sources	10,600,000

[1] Developed by EPA from national production and consumption information using average emission factors. The technique necessarily requires assumptions that cannot be confirmed in every case. EPA anticipates that the figures will change as better information is developed and generalized categories such as "other solvent usage" are more clearly defined.

Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

has issued guidance (or expects to issue guidance soon) to the states on "reasonably available control technology." The technical guidance documents are to aid in planning emission control strategies that will be included in the Implementation Plan revisions.

PREVENTION OF SIGNIFICANT DETERIORATION

The state designations of attainment status also identify areas where air quality is generally better than national standards require (see Figure 1–23). For these areas (and also for clean pockets in non-attainment areas), states are to describe in their Implementation Plan revisions how they will enforce provisions of the 1977 Amendments for prevention of significant deterioration (PSD). In the meantime, EPA's 1974 PSD regulations,[40] revised in accordance with the Amendments,[41] apply nationwide.

The 1977 Amendments require important changes in the EPA PSD regulations:

- Designation of international parks and large National Wilderness Areas, national memorial parks, and National Parks as mandatory Class I areas*
- Expansion of the number of industries required to obtain approval prior to construction
- Stricter control requirements on major new sources
- Requirement to include up to 1 year's monitoring data
- Requirements to protect visibility and other values related to air quality in Class I areas.

EPA first revised its PSD regulations in November 1977[42] to incorporate those changes which were effective immediately. Other revisions incorporating the rest of the changes highlighted above were adopted in June 1978.[43] The regulations require a new source in any of 28 industries with a potential emissions increase of 100 tons or more per year and any other new source with a potential emission increase of 250 tons or more per year to obtain a permit prior to construction. (Potential emissions means uncontrolled emissions.) Larger sources (whose controlled emissions would be greater than 50 tons per year, 1,000 pounds per day, or 100 pounds per hour) are generally subject to more rigorous review than smaller ones.

Shortly after the Amendments passed, a major controversy arose over the effective date of the new PSD permitting requirements. EPA initially interpreted the Amendments as making the requirements effective upon enactment, August 7, 1977. Intense opposition

* Class I areas, never to be reclassified, are the most strictly protected under the Amendments; only very small increases in particulate and sulfur dioxide levels are allowed. Somewhat greater increases are permitted in Class II areas, which the Amendments designate as any PSD area not Class I. States may redesignate Class II areas as Class I or, under certain circumstances, as Class III where still higher increases are allowed but not higher than primary or secondary standards (§ 162(b)).

from industry, some Members of Congress, and the Department of Energy, combined with a reassessment of its legal position, led EPA to propose March 1, 1978, as the effective date. The Environmental Defense Fund sued EPA, claiming that EPA did not have the legal discretion to postpone the effective date of the new permit requirements. A federal District Court determined that it did not have jurisdiction and dismissed the suit; an appeal is pending as of this writing, but the Court of Appeals of the District of Columbia allowed EPA to issue 55 permits which were tied up by the litigation. In addition, numerous companies have challenged the applicability of the final regulations to sources which were not permitted by March 1, 1978, and on which construction had not begun by March 19, 1979.[44]

EFFECTS OF PERMIT REQUIREMENTS ON NEW SOURCES

Many areas of the country, especially the cities, have air quality worse than national ambient standards for some pollutants (usually photochemical oxidants), better for others (such as nitrogen dioxide), and just about at the standard for others (frequently particulates and sulfur dioxide).

The Clean Air Act imposes somewhat different legal standards for controlling emissions from a new source, depending on the attainment status of the area where the source is to be located. Wherever they are, new sources are required to comply with the New Source Performance Standards if EPA has issued one for the industry involved.[45] (Table 1–4 lists the industries for which EPA has issued or proposed standards.) If a new plant would affect an area which exceeds national ambient standards for the pollutant involved, the Amendments impose a stricter control requirement—"lowest achievable emission rate."[46] If the source is proposed for a site where it will affect an area whose air quality is significantly better than national standards, a third requirement applies—"best available control technology" [47] which cannot be less stringent than the New Source Performance Standards. In addition, the "offset policy" discussed earlier applies in nonattainment areas and requires a company with growth plans to find emission offsets from existing sources in the area.

This battery of control requirements can be confusing. EPA is trying to integrate and simplify new source permitting and control requirements and has invited representatives from industry, environmental groups, states, and other federal agencies to advise and assist.

Table 1-4

New Source Performance Standards, October 1977

Source	Number of affected facilities	Number of source-pollutant combinations[1]
Promulgated NSPS		
Steam generators >250 million Btu's per hour (gas-, coal-, and oil-fired)	3	9
Municipal incinerators >50 tons per day	1	1
Portland cement plants	2	2
Nitric acid plants	1	1
Sulfuric acid plants	1	2
Asphalt concrete plants	1	1
Petroleum refineries	2	3
Petroleum storage tanks >40,000 gallons	3	3
Secondary lead smelters	3	3
Secondary brass and bronze refining	3	3
Iron and steel mills	2	2
Sewage treatment plants	1	1
Primary copper smelters	4	5
Primary zinc smelters	2	4
Primary lead smelters	5	7
Primary aluminum reduction	2	4
Coal cleaning plants	2	2
Phosphate fertilizer plants	5	5
Ferroalloy production	1	2
Subtotal	(45)	(60)
Proposed NSPS		
Kraft pulp mills	8	11
Petroleum refineries	1	2
Steam generators >250 million Btu's per hour (lignite-fired)	1	2
Grain elevators	5	5
Lime plants	2	1
Gas turbines	1	2
Subtotal	(18)	(23)
Total	63	83

[1] Opacity standards not counted separately if there are particulate standards for that facility.

Source: U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards.

STATIONARY SOURCE COMPLIANCE AND ENFORCEMENT

EXISTING SOURCES

EPA estimates that more than 200,000 existing stationary sources are subject to emissions limitations in State Implementation Plans.[48] Approximately 23,000 of them are "major" sources (individually capable of emitting more than 100 tons of a pollutant per year). Because these major sources account for approximately 85 percent of all air pollution from existing stationary sources, enforcement efforts have centered on bringing these polluters into compliance.

As of October 1977, 20,358 major stationary sources were in final compliance and another 1,276 were meeting incremental

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cleanup dates in compliance schedules or orders, representing a compliance level of 94 percent (see Table 1–5). EPA conducted 2,369 plant inspections and initiated 662 formal enforcement actions, and the states conducted 25,960 field inspections and 15,646 enforcement actions. The fact that over one-half the inspections led to enforcement actions suggests the need for a high level of continued surveillance to maintain compliance.

Table 1-5

Compliance Status of Major Emitters, October 1977

Sources complying with standards or schedules	21,634
Sources violating standards or schedules	1,225
Sources of unknown compliance status	174
Total identified	23,033

Source: U.S. Environmental Protection Agency, Office of General Counsel.

EPA still has a difficult task ahead, with 1,225 major sources in violation of emission standards or compliance schedules and the compliance status of 174 major sources still in doubt. Unfortunately, most of these 1,399 sources are located in areas which are not meeting National Ambient Air Quality Standards. To make the situation even more difficult, these offenders are often powerplants, steel mills, and other large sources which have a history of reluctance to comply with the standards. These industries frequently claim that standards are too stringent, costs too high, and controls too unreliable to make compliance a reasonable investment.[49]

Past enforcement efforts have generally concentrated on achieving particulate and SO_2 standards. It is now apparent that considerable effort will also be needed to reduce photochemical oxidant levels because many regions are not attaining the ambient standards. Toward this end, EPA plans to reduce hydrocarbon emissions by enforcing existing emission standards and by helping states develop enforceable emission limits in nonattaining regions where state regulations are weak or do not exist.

POWERPLANTS

Nearly two-thirds of all sulfur oxide emissions come from coal- and oil-fired powerplants.[50] The plants are also responsible for heavy concentrations of particulates in the ambient air. Of the nation's 623 large coal- and oil-fired powerplants, approximately 74 percent operate in compliance with SO_2 emission limitations. An additional 17 percent are in violation of the standards, and the remaining 9 percent are under EPA review. Included in the latter category are 34 plants in Indiana, where enforcement of SIP SO_2 standards has been stayed pending court action.[51] Seventy-six enforcement actions

initiated by EPA and the states during the past year were responsible for improved compliance status by many of these sources.[52]

The two major approaches to reducing SO_2 emissions from powerplants are use of low sulfur fuel and flue gas desulfurization (FGD) systems (scrubbers). At this time, 139 scrubber units have been installed, are under construction, or are being planned. Technological advances have produced new regenerable FGD systems that reduce the waste disposal burden and are capable of achieving 90 percent or better efficiency.

In the coming year state and federal enforcement agencies will face the problem of maintaining SO_2 standards in the midst of a potential increase in coal conversions ordered by the Department of Energy. Activities will include monitoring compliance with existing emissions controls, setting and enforcing interim emission limitations where necessary, and coordinating with DOE to identify plants with the potential to convert to coal.

Present compliance by powerplants with standards for particulate matter is worse than that for SO_2, with only 62 percent of the 623 large plants in compliance.[53] The probable reason for this difference is that a few powerplants switched to low sulfur coal to meet SO_2 standards but have not yet added hardware to control particulate emissions adequately. Sometimes low sulfur coal aggravates the particulate problem—western low sulfur coal is often lower in energy value than the higher sulfur coal that it replaces, and more coal is burned per unit of electricity generated, thus producing more particulates.

PRIMARY NONFERROUS SMELTERS

The nation's 27 primary copper, lead, and zinc smelters account for approximately 10 percent of the total sulfur oxides emitted by stationary sources.[54] In Salt Lake City and other cities, a single smelter has been the major cause of the area's nonattainment designation for sulfur dioxide. Major modification of a Kennecott smelter outside Salt Lake City may change the air quality designation from nonattaining to attaining.

Eleven primary smelters are now operating in full compliance with State Implementation Plan SO_2 standards or compliance schedules. Thirteen are operating in violation of standards or schedules for SO_2. Twenty smelters are located in areas where no applicable SIP for SO_2 is in effect, where the SIP is inadequate and SO_2 standards are needed, or where the SIP is the subject of litigation.

The Clean Air Act Amendments of 1977 establish eligibility requirements deferring final compliance dates with SO_2 emission limitations for up to 10 years for smelters.[55] It is expected that many smelters will apply for orders during 1978 and 1979. (The economics of compliance by metal smelters are discussed in Chapter 10.)

IRON AND STEEL MILLS—COKE PLANTS

Fifty-three integrated iron and steel plants produce approximately 90 percent of all U.S. raw steel. These plants consist of 591 sources of air pollution—coke plants, sinter plants, blast furnace shops, and steelmaking shops (open hearth, electric arc, or basic oxygen furnaces). Approximately 15 percent are operating in final compliance, and 26 percent are on schedules leading to compliance in the near future. The status of 10 percent is unknown. Thus almost one-half of all integrated steel processes are in violation of applicable standards. During the past year, EPA initiated 43 enforcement actions against these violators.[56]

In the Monongahela River valley, where many steel plants are located, most of the ambient air monitoring stations reported violations of the TSP and/or SO_2 standards, but stations elsewhere in the Pittsburgh area reported ambient levels at or slightly below the standards. As Figure 1–24 shows, these steel plants are apparently responsible for these air quality violations in the Monongahela River Valley.

The steel industry particularly has resisted controls on fugitive particulate emissions—emissions which do not go up a stack. The industry argues that the cost of control is excessive and that the impact of fugitive emissions on air quality is negligible. However, several studies have shown that fugitive emissions from iron and steel plants are large in mass and small in size and have a major impact on ambient air quality.[57]

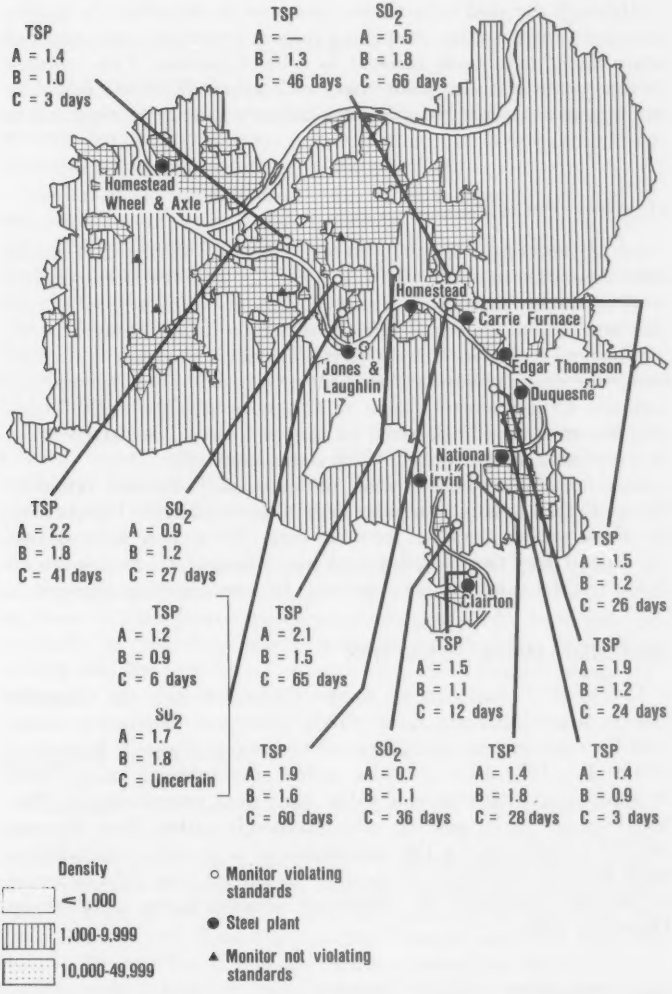
Despite some industry reluctance, there have been some improvements during the past year. For example, seven plants installed equipment for controlling fugitive emissions from charging and tapping operations of basic oxygen furnaces—the first controls for emissions from this source in the United States. Most plants are expected to apply controls on coke oven pushing and charging operations. These controls will reduce fugitive emissions containing carcinogenic substances.[58]

Current financial difficulties of the industry need not set back efforts to meet air quality standards. A report on the steel industry by an interagency task force headed by the Treasury Department (*The Solomon Report*) did not recommend relaxation of environmental standards or more lenient treatment. It did recommend changes in regulation to reduce the economic costs of control without sacrificing a cleaner environment:

- Increased openness and access among EPA, the industry, and the public
- Coordination of standardsetting and enforcement efforts for the steel industry under air and water pollution, toxic substances, and solid waste statutes
- Coordination between EPA and the Occupational Safety and Health Administration of the Labor Department on industry regulations

Figure 1-24

TSP and SO_2 Violations in the Monongahela River Valley 1975



A Ratio of geometric mean to standard (75 micrograms per cubic meter)
B Ratio of second maximum 24-hour value to primary standard (260 micrograms per cubic meter)
C Number of days violating primary 24-hour standard (260 micrograms per cubic meter)

Source: Based on U.S. Environmental Protection Agency, SAROAD data system and U.S. Bureau of the Census data.

- Examination by EPA of the emission offset policy for locating new polluting facilities in nonattaining areas, including the feasibility of "banking" reductions to offset future emission increases.[59]

Although the steel industry has problems in achieving air quality standards, there are no compelling reasons to expect lesser levels of achievement than those reached by other industries. *The Solomon Report* reaffirmed the point that, with some additional flexibility in the regulatory process, the steel industry should be expected to comply.

FEDERAL FACILITIES

As of November 1, 1977, 68 (17 percent) of the 393 major federal facilities subject to the Clean Air Act were not in compliance with air quality standards or emission limitations because of operation and maintenance problems, construction delays, delays in testing for final compliance, and delays, deferrals, or failures to identify budget needs for pollution abatement projects. Of the noncomplying facilities, 45 (66 percent) were on an approved construction schedule; however, 24 (35 percent) of the 45 were not expected to be in compliance by the July 1, 1979, statutory deadline.[60]

Late in 1977, 120 Members of Congress petitioned President Carter to take action to improve federal compliance.[61] The Administration's budget proposals for fiscal year 1979 include $363 million for federal facilities compliance, a sum thought to be enough to finance initial compliance investments by noncomplying agencies.

NONCOMPLIANCE PENALTIES

In the 1977 Amendments to the Clean Air Act, the Congress enacted a new noncompliance penalty procedure designed to eliminate the economic advantage gained by noncompliance.[62] Beginning in mid–July 1979, EPA penalties against noncomplying sources were to approximate the economic value gains from noncompliance. The penalties are to be assessed administratively rather than through judicial procedures. In the calculation of a penalty, expenditures made toward compliance are to be taken into account. EPA expected to propose regulations to implement noncompliance penalties by December 1978.

NEW SOURCES

There are currently 646 new plants and facilities in 19 source categories subject to new source performance standards. Approximately 82 percent of them are operating in full compliance with regulations. Delegation of enforcement authority to state and local governments is crucial to enforcing the requirements because EPA

regional offices are not staffed to handle enforcement. EPA had delegated enforcement responsibility to 34 states and 27 localities by November 1977, compared to 20 states and 18 localities in September 1976.[63]

HAZARDOUS AIR POLLUTANTS

As of October 1977, 1,162 sources of air pollution were subject to the hazardous air pollutant standards regulating emissions of asbestos, beryllium, mercury, and vinyl chloride. Approximately 95 percent were in compliance with the standards.

Vinyl chloride standards applicable to 59 existing sources and all new sources were promulgated on October 21, 1976. It was a major EPA effort to inspect these sources and evaluate the many applications for compliance waivers. Nearly all the sources have now been inspected and about 50 compliance waivers issued. Sources operating under waivers must be monitored by EPA to ensure timely installation of control equipment and compliance with interim emission limits. All sources with waivers must be in final compliance by October 21, 1978.

As the scope of the hazardous air pollutant regulations widens, EPA is urging state and local agencies to request enforcement authority. Through 1977 authority had been delegated to 25 state governments with 18 or more states interested in or negotiating for delegation.[64]

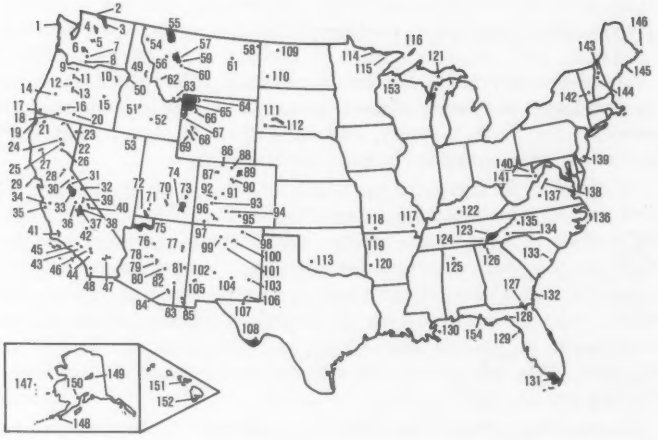
An important Supreme Court decision set back EPA efforts to adopt and enforce asbestos control requirements. In *Adamo Wrecking Co.* v. *United States,* the Court invalidated EPA's work practice standards for controlling asbestos emissions from building demolition, holding that the work practice rules were not "emission standards" within the meaning of the 1970 Clean Air Act.[65]

VISIBILITY PROTECTION

When the 1977 Clean Air Act Amendments were debated,[66] the air quality in and around National Parks, Wilderness Areas, and other unique areas was a subject of concerned congressional attention. Witnesses at congressional hearings reported deteriorated visibility in some of the nation's most spectacular areas—including the Grand Canyon and Bryce Canyon. For example, emissions from the Navaho Power Plant near Page, Arizona, sometimes fill the Grand Canyon with a layer of haze, reducing visibility to less than 15 miles and obscuring the opposite canyon rim.[67] The Congress responded by stating as a national goal protection of visibility in mandatory Class I federal areas when the impairment results from manmade air pollution.[68] Figure 1–25 shows the areas. Further, the Congress placed an affirmative responsibility on federal land managers to protect air quality values, including visibility, in all Class I

Figure 1-25

Mandatory Class I Areas



1. Olympic
2. Pasayten
3. North Cascades
4. Glacier Peak
5. Alpine Lakes
6. Mount Ranier
7. Goat Rocks
8. Mt. Adams
9. Mt. Hood
10. Eagle Cap
11. Mt. Jefferson
12. Mt. Washington
13. Three Sisters
14. Diamond Peak
15. Strawberry Mtn.
16. Crater Lake
17. Kalmiopsis
18. Mountain Lakes
19. Redwood
20. Gearhart Mtn.
21. Marble Mtn.
22. Lava Beds
23. South Warner
24. Thousand Lakes
25. Lassen
26. Caribou
27. Yolla-Bolly-Middle-Eel
28. Desolation
29. Pt. Reyes
30. Mokelumne
31. Emigrant
32. Hoover
33. Yosemite
34. Pinnacles
35. Ventana
36. Kaiser
37. Kings Canyon
38. Sequoia
39. Minarets
40. John Muir
41. San Rafael
42. Dome Land
43. Cucamonga
44. San Jacinto
45. San Gabriel
46. San Gorgonio
47. Joshua Tree
48. Agua Tibia
49. Selway-Bitterroot
50. Hell's Canyon
51. Sawtooth
52. Craters of the Moon
53. Jarbridge
54. Cabinet Mtns.
55. Glacier
56. Mission Mtn.
57. Bob Marshall
58. Medicine Lake
59. Scapegoat
60. Gates of the Mountain
61. UL Bend
62. Anaconda Pintlar
63. Red Rock Lake
64. North Absaroka
65. Yellowstone
66. Washakie
67. Grand Teton
68. Fitzpatrick
69. Bridger
70. Capitol Reef
71. Bryce Canyon
72. Zion
73. Arches
74. Canyonlands
75. Grand Canyon
76. Sycamore Canyon
77. Petrified Forest
78. Pine Mt.
79. Mazatzal
80. Sierra Ancha
81. Mt. Baldy
82. Superstition
83. Galiuro
84. Saguaro
85. Chiricahua
86. Mt. Zirkel
87. Flat Tops
88. Rawah
89. Rocky Mtn.
90. Eagles Nest
91. Maroon Bells Snowmass
92. West Elk
93. Black Canyon
94. La Garita
95. Great Sand Dunes
96. Weminuche
97. Mesa Verde
98. Wheeler
99. San Pedro Parks
100. Pecos
101. Bandelier
102. Bosque del Apache
103. Salt Ck
104. White Mtn.
105. Gila
106. Carlsbad Caverns
107. Guadalupe
108. Big Bend
109. Lostwood
110. Theodore Roosevelt
111. Badlands
112. Wind Cave
113. Witchita Mtns.
114. Voyageurs
115. Boundary Waters Canoe Area
116. Isle Royale
117. Mingo
118. Hercules-Glades
119. Upper Buffalo
120. Caney Creek
121. Seney
122. Mammoth Cave
123. Great Smokey Mtns.
124. Joyce Kilmer-Slickrock
125. Sipsey
126. Cohotta
127. Okefenokee
128. St. Marks
129. Chassahowitzka
130. Breton
131. Everglades
132. Wolf Island
133. Cape Romain
134. Shining Rock
135. Linville Gorge
136. Swanquarter
137. James River Face
138. Shenandoah
139. Brigantine
140. Dolly Sods
141. Otter Creek
142. Lye Brook
143. Great Gulf
144. Presidential Range-Dry River
145. Acadia
146. Moosehorn
147. Bering Sea
148. Simeonof
149. Mt. McKinley
150. Tuxedni
151. Haleakala
152. Hawaii Volcanoes
153. Rainbow Lake
154. Brodwell Bay

[1]Italicized names are areas not recommended where visibility is an important value.

Source: National Park Service.

areas through review of new sources before construction.[69] In February 1978, the Department of the Interior recommended to EPA a number of areas where visibility is an important value.[70] They are listed in Table 1–6.

Impaired visibility[71] is the most easily perceived effect of air pollution. Haze is especially objectionable when it makes a scenic vista less visible and less esthetically satisfying. Visibility degradation is also one of the few effects of air pollution that is well-understood and can be measured directly and objectively with existing instruments. Because visual air quality is sensitive to very small concentrations of pollutants in the form of fine particles, stringent control and planning may well be required to meet the visibility protection requirements of the Clean Air Act.

The levels of impairment caused by copper smelters are predictable, and during the smelter strike of 1967–68, improved visibility throughout the Southwest was commensurate with the decrease in sulfur emissions. If the trend of increasing visibility impairment caused by increased power production in the Southwest is confirmed by more detailed monitoring, it will be necessary to control existing pollution sources (mainly smelters and powerplants) and to plan and control all industrial sources which may be introduced into the pristine parts of the western United States. Figures 1–26 and 1–27 locate predicted sulfur oxide and nitrogen oxide emissions from powerplants proposed to 1985.

Impaired visibility may result from a decrease in visual range or from atmospheric discoloration. Visual range—the distance over which people can see objects—is one of the most variable of atmospheric properties. Visual range for large, dark objects, mountains viewed against the horizon, for example, is related to the extinction coefficient, a measure of how much light is lost along the path of a light beam. (With additional information the visual range for snow-capped mountains can also be defined.) If pollutants are absent, the visual range at sea level is limited only by the scattering of naturally occurring gases or by topography. The visual range approaches 260 kilometers (162.5 miles) under such conditions. Humidity is also a factor. Both theory and measurements show that for relative humidities of less than 70 percent, the extinction coefficient is proportional to the concentration of fine particles in the air.

The addition of approximately 1.5 micrograms per cubic meter of fine particles to clean air decreases visual range by 30 percent, for example, from 260 to 200 kilometers (160–125 miles) and increases the haziness of dark objects (as near as 10 kilometers (6.25 miles)).

Most fine particles in a polluted atmosphere are sulfate compounds, although nitrate compounds may also be significant.[72] Most of the fine particles are formed in the air from sulfur dioxide and nitric oxide emitted from smelters and powerplants. The process of generating fine particles from gases takes place over several days, with extensive vertical mixing and horizontal transport. Because natural removal of fine particles is slow, visibility impairment from haze is

Table 1-6

Class I Areas Designated under the Clean Air Act

Area name	State	Acreage
Sipsey Wild	Alabama	12,646
Bering Sea Wild	Alaska	41,113
Mount McKinley NP	Alaska	1,939,493
Simeonof Wild	Alaska	25,141
Tuxedni Wild	Alaska	6,402
Chiricahua National Monument Wild	Arizona	9,440
Chiricahua Wild	Arizona	18,000
Galiuro Wild	Arizona	52,717
Grand Canyon NP	Arizona	1,176,913
Mazatzal Wild	Arizona	205,137
Mount Baldy Wild	Arizona	6,975
Petrified Forest NP	Arizona	93,493
Pine Mountain Wild	Arizona	20,061
Saguaro Wild	Arizona	71,400
Sierra Ancha Wild	Arizona	20,850
Superstition Wild	Arizona	124,117
Sycamore Canyon Wild	Arizona	47,757
Caney Creek Wild	Arkansas	14,344
Upper Buffalo Wild	Arkansas	9,912
Agua Tibia Wild	California	15,934
Caribou Wild	California	19,080
Cucamonga Wild	California	9,022
Desolation Wild	California	63,469
Dome Land Wild	California	62,206
Emigrant Wild	California	104,311
Hoover Wild	California	47,916
John Muir Wild	California	484,673
Joshua Tree Wild	California	429,690
Kaiser Wild	California	22,500
Kings Canyon NP	California	459,994
Lassen Volcanic NP	California	105,800
Lava Beds Wild	California	28,640
Marble Mountain Wild	California	213,743
Minarets Wild	California	109,434
Mokelumne Wild	California	50,400
Pinnacles Wild	California	12,952
Point Reyes Wild	California	25,370
Redwood NP	California	27,792
San Gabriel Wild	California	36,137
San Gorgonio Wild	California	34,644
San Jacinto Wild	California	20,564
San Rafael Wild	California	142,722
Sequoia NP	California	386,642
South Warner Wild	California	68,507
Thousand Lakes Wild	California	15,695
Ventana Wild	California	95,152
Yola-Bolly-Middle-Eel Wild	California	109,091
Yosemite NP	California	759,172
Black Canyon of the Gunnison Wild	Colorado	11,180
Eagles Nest Wild	Colorado	133,910
Flat Tops Wild	Colorado	235,230
Great Sand Dunes Wild	Colorado	33,450
La Garita Wild	Colorado	48,486
Maroon Bells-Snowmass Wild	Colorado	71,060
Mesa Verde NP	Colorado	51,488
Mount Zirkel Wild	Colorado	72,472
Rawah Wild	Colorado	26,674
Rocky Mountain NP	Colorado	263,138
Weminuche Wild	Colorado	400,907
West Elk Wild	Colorado	61,412

Area name	State	Acreage
Bradwell Bay Wild[1]	Florida	23,432
Chassahowitzka Wild	Florida	23,360
Everglades NP	Florida	1,397,429
St. Marks Wild	Florida	17,745
Cohotta Wild	Georgia	33,776
Okefenokee Wild	Georgia	343,850
Wolf Island Wild	Georgia	5,126
Haleakala NP	Hawaii	27,208
Hawaii Volcanoes	Hawaii	217,029
Craters of the Moon Wild	Idaho	43,243
Hells Canyon Wild[2]	Idaho	83,800
Sawtooth Wild	Idaho	216,383
Selway-Bitterroot Wild[3]	Idaho	988,770
Yellowstone NP[4]	Idaho	31,488
Mammoth Cave NP	Kentucky	51,303
Breton Wild	Louisiana	+5,000
Acadia NP	Maine	37,503
Moosehorn Wild	Maine	7,501
(Edmunds Unit)		(2,782)
(Baring Unit)		(4,719)
Isle Royale NP	Michigan	542,428
Seney Wild	Michigan	25,150
Boundary Waters Canoe Area Wild	Minnesota	747,840
Voyageurs NP	Minnesota	114,964
Hercules-Glades Wild	Missouri	12,315
Mingo Wild	Missouri	8,000
Anaconda-Pintlar Wild	Montana	157,803
Bob Marshall Wild	Montana	950,000
Cabinet Mountains Wild	Montana	94,272
Gates of the Mountain Wild	Montana	28,562
Glacier NP	Montana	1,012,599
Medicine Lake Wild	Montana	11,366
Mission Mountain Wild	Montana	73,877
Red Rock Lakes Wild	Montana	32,350
Scapegoat Wild	Montana	239,295
Selway-Bitterroot Wild[3]	Montana	251,930
U.L. Bend Wild	Montana	20,890
Yellowstone NP[4]	Montana	167,624
Jarbidge Wild	Nevada	64,667
Great Gulf Wild	New Hampshire	5,552
Presidential Range-Dry River Wild	New Hampshire	20,000
Brigantine Wild	New Jersey	6,603
Bandelier Wild	New Mexico	23,267
Bosque del Apache Wild	New Mexico	30,850
Carlsbad Caverns NP	New Mexico	46,435
Gila Wild	New Mexico	433,690
Pecos Wild	New Mexico	167,416
Salt Creek Wild	New Mexico	8,500
San Pedro Parks Wild	New Mexico	41,132
Wheeler Peak Wild	New Mexico	6,027
White Mountain Wild	New Mexico	31,171
Great Smoky Mountain NP[5]	North Carolina	273,551
Joyce Kilmer-Slickrock Wild[6]	North Carolina	10,201
Linville Gorge Wild	North Carolina	7,575
Shining Rock Wild	North Carolina	13,350
Swanguarter Wild	North Carolina	9,000
Lostwood Wild	North Dakota	5,557
Theodore Roosevelt NMP	North Dakota	69,675
Wichita Mountains Wild	Oklahoma	8,900
Crater Lake NP	Oregon	160,290
Diamond Peak Wild	Oregon	36,637
Eagle Cap Wild	Oregon	293,476
Gearhart Mountain Wild	Oregon	18,709
Hells Canyon Wild[2]	Oregon	108,900

Area name	State	Acreage
Kalmiopsis Wild	Oregon	76,900
Mountain Lakes Wild	Oregon	23,071
Mount Hood Wild	Oregon	14,160
Mount Jefferson Wild	Oregon	100,208
Mount Washington Wild	Oregon	46,116
Strawberry Mountain Wild	Oregon	33,003
Three Sisters Wild	Oregon	199,902
Cape Romain Wild	South Carolina	28,000
Badlands Wild	South Dakota	64,250
Wind Cave NP	South Dakota	28,060
Great Smoky Mountains NP[5]	Tennessee	241,207
Joyce Kilmer–Sliprock Wild[6]	Tennessee	3,832
Big Bend NP	Texas	708,118
Guadalupe Mountains NP	Texas	76,292
Arches NP	Utah	65,098
Bryce Canyon NP	Utah	35,832
Canyonlands NP	Utah	337,570
Capitol Reef NP	Utah	221,896
Zion NP	Utah	142,462
Lye Brook Wild	Vermont	12,430
Virgin Islands NP	Virgin Islands	12,295
James River Face Wild	Virginia	8,703
Shenandoah NP	Virginia	190,535
Alpine Lakes Wild	Washington	303,508
Glacier Peak Wild	Washington	464,258
Goat Rocks Wild	Washington	82,680
Mount Adams Wild	Washington	32,356
Mount Rainier NP	Washington	235,239
North Cascades NP	Washington	503,277
Olympic NP	Washington	892,578
Pasayten Wild	Washington	505,524
Dolly Sods Wild	West Virginia	10,215
Otter Creek Wild	West Virginia	20,000
Rainbow Lake Wild[1]	Wisconsin	6,388
Bridger Wild	Wyoming	392,160
Fitzpatrick Wild	Wyoming	191,103
Grand Teton NP	Wyoming	305,504
North Absaroka Wild	Wyoming	351,104
Teton Wild	Wyoming	557,311
Washakie Wild	Wyoming	686,584
Yellowstone NP[4]	Wyoming	2,020,625
Area name	**Province**	**Acreage**
Roosevelt Campobello International Park[7]	New Brunswick, Canada	2,721

Wild = Wilderness
NP = National Park
NMP = National Memorial Park

[1] Final determination that the area is not one where visability is an important value.

[2] Hells Canyon Wilderness, 193,840 acres overall, of which 108,900 acres are in Oregon and 83,800 acres are in Idaho.

[3] Selway-Bitterroot Wilderness, 1,240,618 acres overall, of which 988,770 acres are in Idaho and 25,930 acres are in Montana.

[4] Yellowstone National Park, 2,219,737 acres overall, of which 2,020,625 acres are in Wyoming, 167,624 acres are in Montana, and 31,488 acres are in Idaho.

[5] Great Smoky Mountains National Park, 514,577 acres overall, of which 273,551 acres are in North Carolina, and 241,207 acres are in Tennessee.

[6] Joyce Kilmer-Slickrock Wilderness, 14,033 acres overall, of which 10,201 acres are in North Carolina, and 3,832 acres are in Tennessee.

[7] Section 162(a) designates all international parks as mandatory Class I areas. This designation indicates congressional intent to prevent visibility impairment from U.S. air pollution sources.

Source: 43 Fed. Reg. 7725-26 (1978).

Figure 1-26

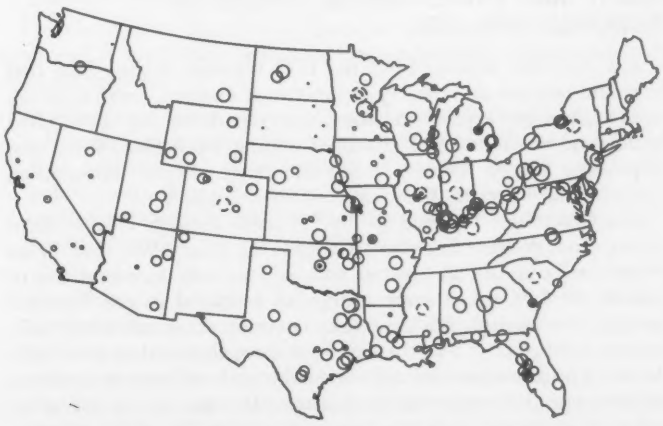
SO_X Emissions from Proposed Powerplants[1]

[1]Circle size reflects proposed plant size; broken circle indicates undetermined site.

Source: U.S. Environmental Protection Agency, Energy Strategy Branch, based on U.S. Department of Energy Generating Reference File data.

Figure 1-27

NO_X Emissions from Proposed Powerplants[1]



[1]Circle size reflects proposed plant size; broken circle indicates undetermined site.

Source: U.S. Environmental Protection Agency, Energy Strategy Branch, based on U.S. Department of Energy Generating Reference File data.

relatively uniform over distances of perhaps 1,000 kilometers (625 miles). Thus haze is a regional problem, extending far beyond the source of fine particulate emissions. Plumes are exceptions to this regional problem; they can be traced to specific sources and substances and therefore are a more direct problem of control than haze covering an entire region.

Discoloration of the atmosphere results from absorption of light by particles or gases. For example, the dun color of NO_2 is a result of its absorption of blue and ultraviolet light. Light passing through an NO_2 plume has the blue light removed, and the plume appears yellow or even brown.

Particles absorb light in a similar way. If the air is extremely clean (less than approximately 1 microgram per cubic meter of fine particles), dark objects are seen to be blue; with even a few micrograms per cubic meter change, the color is more neutral. Dark objects 10 kilometers (6.25 miles) or more away appear to be behind a haze; the color of the haze depends on the amount of scatter by fine particles.

Because most of the mass of fine particles enters the atmosphere in gaseous form, the technology to protect visibility will be designed to control SO_2, NO_x, and other reactant gases as well as emissions of fine particulates themselves. However, controls for a single plant may meet the PSD requirements of the Clean Air Act in terms of the plant's impacts on a Class I area; yet the plant's emissions may aggravate the regional problem. The regional load of fine particles and their precursors may well be the key regulatory issue in protecting visibility. If so, then siting and tradeoff policies involving rollback of emissions from existing sources must be considered in addition to requirements for the best available control technology for new sources.

HEALTH AND ENVIRONMENTAL EFFECTS OF INCREASED COAL USE

The President announced in the 1977 National Energy Plan that he would convene an advisory committee of medical, environmental, and engineering experts to study and report on the anticipated health and environmental effects of relying more heavily on coal to produce energy. Table 1–7 lists the range of coal consumption forecasts that were the base for committee analyses.

The Committee reported to the President through Health, Education, and Welfare Secretary Califano in June 1978 that in its judgment "it is safe to proceed with significantly increased use of coal in the U.S. to generate energy, as proposed in the National Energy Plan through 1985, if strong environmental and safety policies are followed." [73] But the Committee concluded that even with the best mitigation policies, adverse health and environmental effects would occur. It recommended rigorous adherence to the following policies:

- Compliance with federal and state air, water, and solid waste regulations

Table 1-7

Coal Consumption Forecasts

(million tons)

Case	Utility	Industrial	Metallurgical	Export	Other	Total
1976 Base case	444	65	85	65	6	665
1985 Estimates						
BAU[1]	783	101	105	90	7	1,066
NEP[2]	779	278	105	90	13	1,265
House-Senate Conference	779	198	105	90	13	1,185
National Coal Association	820-850	130-160	80-110	80-110	7	1,117-1,237
American Gas Association	680-705	170-375[3]		NE	NE	850-1,000

NE = Not estimated

[1] "Business as usual" represents a forecast of coal use that would occur in the absence of the National Energy Plan, largely as the result of reductions in availability and increases in prices of oil and natural gas.

[2] The National Energy Plan represents a forecast of incremental coal use, in addition to BAU, that the National Energy Plan as proposed in April 1977 would stimulate.

[3] Industrial and metallurgical consumption.

Sources: BAU and NEP, U.S. Department of Energy official estimates; House-Senate Conference case is an informal estimate by U.S. Department of Energy staff, December 1977; NCA case is the most current staff estimate supplied to the Committee on Health and Environmental Effects of Increased Coal Utilization; AGA case is based on very restrictive interpretations of the Clean Air Act Amendments.

- Universal adoption and proper operation of best available control technology on new facilities
- Compliance with surface mine reclamation standards
- Compliance with mine health and safety standards
- Judicious siting of coal-fired facilities.

The Committee identified six issues which it said warrant "urgent attention" if the Nation is to minimize undesirable consequences of increased coal use:

- Air pollution health effects—Current standards may not provide adequate health protection from all coal combustion products. The evidence that some acidic particles have greater impact on public health than other particles increases our need to resolve the critical problems related to the transport, transformation, and health effects of the gas-aerosol complex.
- Coal mine worker health and safety—Strict enforcement of the Federal Coal Mine Safety and Health Act of 1977 should further reduce the risks to workers in the coal industry. Even with strict enforcement, in order to be certain that present standards provide adequate protection, effective health monitoring and assessment will be necessary. Continued improvement in miner safety will require increased education, especially for new miners. New developments, such as use of diesel-powered underground equipment, require further study of potential deleterious health effects.

- Global effects of carbon dioxide in the atmosphere—Combustion of fossil fuels, and especially coal, is increasing global atmospheric CO_2. This could induce climatic changes with potential for generating global sociopolitical disruption after 2025. It is urgent that we continue a strong research program to provide a sound basis for action no later than 1985. Because this problem is global in character, the United States should initiate a continuing international dialogue immediately.
- Acid fallout—Emissions of SO_2, particularly from coal, and NO_x from all fossil fuel combustion have increased the acidity of precipitation in the northeastern United States. This has decreased fish populations in many lakes and may already be reducing forest and agricultural productivity. Because both BAU and the NEP are projected to increase emissions of SO_2 and NO_x, a major study is needed to verify causal relationships and project future effects.
- Trace elements—Increased use of coal results in wastes that contain trace elements, many of which are toxic. These elements can leach and migrate into water or enter food chains in quantities which could impact public health and environmental quality. More data are needed to assess the extent to which these elements enter into the biosphere.
- Reclamation of arid lands—Enforcement of the Surface Control and Reclamation Act of 1977 will mitigate many adverse environmental effects of surface mining. However, it is not certain that some arid areas can be restored, even following full compliance. Prudence dictates that surface mining be deferred in these arid areas when information about their reclaimability is incomplete.[74]

CONTROLLING VEHICLE EMISSIONS

The most visible controversies on controlling automobile pollution have centered on standards for tailpipe emissions. Enforcing the standards, although less publicized, is complex. Enforcement begins with EPA certification of prototype engines to determine whether their design is adequate to meet standards. Based on this testing, EPA certifies engine families to be used in production. EPA also selectively tests vehicles on the assembly line to see whether production models also meet standards. Once the cars are on the road, EPA may recall entire fleets for major defects. EPA also limits the amount of lead in gasoline and encourages states to require regular inspection and maintenance to ensure that autos continue to meet standards.

Historically, the auto makers were able to submit vehicles for certification that were specially maintained during EPA tests. Production line cars would not receive the same attention during manufacturing or use, and performance frequently failed to meet emis-

sions standards.[75] EPA is addressing the problem by limiting the maintenance on the test vehicles, beginning to test vehicles on the assembly line, and accelerating the recall of automobiles with defective emission control components. In 1978, for example, EPA ordered recall of the entire 1976 fleet of American Motors cars to repair a defect in the exhaust gas recovery (EGR) systems. EPA expects that these new efforts, along with state inspection and maintenance programs, will cut down some of the disparity between certification testing results and actual performance.

State legislative activity on inspection and maintenance programs (I/M) increased in 1977.[76] Colorado requires annual inspection of all 1977 and later model year vehicles of gross vehicle weight of 8,500 pounds or less in the nine "Front Range" counties with serious oxidant problems, including Denver and Colorado Springs. Testing is to begin on January 1, 1980. Nevada passed a mandatory I/M bill for Clark County (Las Vegas) and Washoe County (Reno). The existing inspection and maintenance program for vehicles changing ownership will now be mandatory for all cars on July 1, 1979, in both counties. In Connecticut, enabling legislation for an I/M program was passed and signed into law in April 1978.

Fully mandatory programs include the state of New Jersey; the Portland, Oregon, metropolitan area; Maricopa and Pima Counties (Phoenix and Tucson); and Cincinnati.

Rhode Island began implementing a private garage-based program in November 1977. Inspections were mandatory from the beginning; voluntary maintenance will become mandatory in January 1979.

California made a significant step toward mandatory I/M for the South Coast Air Basin, encompassing the entire 6-county Los Angeles metropolitan area. In June 1977 the state contracted with a private firm to manage a change-of-ownership I/M program; testing is scheduled to begin in January 1979.

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51. *Ibid.*
52. U.S. Environmental Protection Agency, Compliance Data System, *supra* note 49.
53. *Ibid.*
54. U.S. Environmental Protection Agency, "Progress," *supra* note 48.
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CHAPTER 2

WATER QUALITY

The year 1977 was a milestone for water pollution control programs. Deadlines for many requirements of the 1972 Federal Water Pollution Control Act Amendments arrived, and the Act was amended by the Clean Water Act of 1977.[1] Thus 1978 begins a new phase in water pollution control.

Even if there were uniform nationwide data available, no one statement could adequately describe U.S. water quality. It is difficult because the quality of water is judged by many variables for many purposes. We have set an ultimate goal of achieving "chemical, physical, and biological integrity of the Nation's waters" and a more immediate objective, wherever attainable, of achieving "water quality which provides for the protection and propagation of fish, shell fish, and wildlife and provides for recreation in and on the water" by 1983.[2] These goals require monitoring and controlling a host of pollutants with different chemical, physical, and biological effects.

Overall, national efforts of the past decade to improve water quality are beginning to show results. There is evidence of improvement in many specific places and in the trends data for a few pollutants and a few years so far.[3] Continued improvement should be evident in the next several years as the investments in pollution control for industry and municipalities pay off. But we are a very long way from our goals, and few areas of the country appear free of water quality problems. Pollution from nonpoint sources remains widespread, and control measures are still rudimentary. In addition, toxic pollutants in ground and surface waters appear to be a significant problem which we are just beginning to understand and control.

This chapter first takes a satellite view of the major water pollution problems on which the most data have been collected. It then looks at various sources and kinds of pollution and the control measures adopted in order to achieve "fishable" and "swimmable" waters by 1983. Last are considered some issues that may well become more important with the passage of time. Among them are what constitutes "biological integrity" and, once it is defined, how to reach that elusive goal. It is important to recognize that water quality is but one element of a complex environment and that it is related to air

quality, the land, and other natural resources. All need to be managed with thought to the others.

NATIONAL PATTERNS OF WATER QUALITY

CONDITIONS

In a recent summary of state reports to the Congress[4] prepared according to requirements of Section 305(b) of the Clean Water Act, the Environmental Protection Agency indicated that 95 percent of the 246 hydrological drainage basins in the United States were affected by water pollution in 1977.* This summary figure oversimplifies the situation, however, A basin identified as "affected" may not be affected in its entirety; pollution may be limited to one or two short segments. On the other hand, the failure to report a problem does not necessarily mean that the basin is free of pollution; it may simply mean that monitoring data are lacking. This lack of data is particularly true of potential carcinogens or other toxic pollutants.

The nation's most widespread water quality problems, as perceived by state officials, are high levels of nutrients, bacterial pollution, high concentrations of suspended sediment, and heavy loading of oxygen-demanding material and consequent oxygen depletion in streams.

Another nationwide system for reporting water quality is the National Stream Quality Accounting Network of the U.S. Geological Survey.[5] In operation since 1974, NASQAN collects uniform data at the downstream ends of 349 hydrologic accounting units.† Data are taken at or near the mouths of all major U.S. rivers and their principal tributaries.

There are important differences between NASQAN and the state reports on water quality patterns. First, reporting is based on different hydrologic subdivisions of the United States. Second, states report problems anywhere in a basin, whereas NASQAN reports on the downstream ends of the accounting units (basins). The result is that state summaries tend to represent the worst condition in each basin, and NASQAN data generally represent downstream conditions, masking out the best and the worst streams in most areas. Further, problems identified by the states are not clearly and uniformly defined, whereas NASQAN reports pollutant concentrations uniformly.

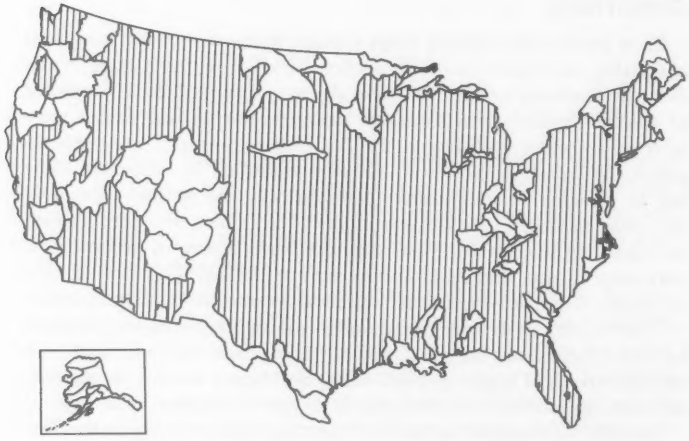
Despite the differences, the two systems generally agree on nationwide patterns of water quality as represented by nitrogen and phosphorus and by bacterial pollution. The patterns are shown in Figures 2–1 to 2–4. Unfortunately, NASQAN data on sediment and oxygen are too few to provide a comparison with the state data.

* There are several systems for hydrologic subdivisions in the United States. EPA's 246 basins are the basis for Figures 2–1, 2–3, 2–6, 2–8 to 2–12, 2–14, 2–16, and 2–17.

† NASQAN uses the Water Resources Council and U.S. Geological Survey system of hierarchical hydrological subdivisions; there are 21 regions, 220 subregions, and 349 accounting units. The accounting units are the basis for Figures 2–2, 2–4, 2–5, and 2–10.

Figure 2-1

Basins Affected[1] by Nutrients from Point Sources 1977



[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Excessive levels of nitrogen and phosphorus cause serious problems because these nutrients accelerate algal growth, which is part of eutrophication.

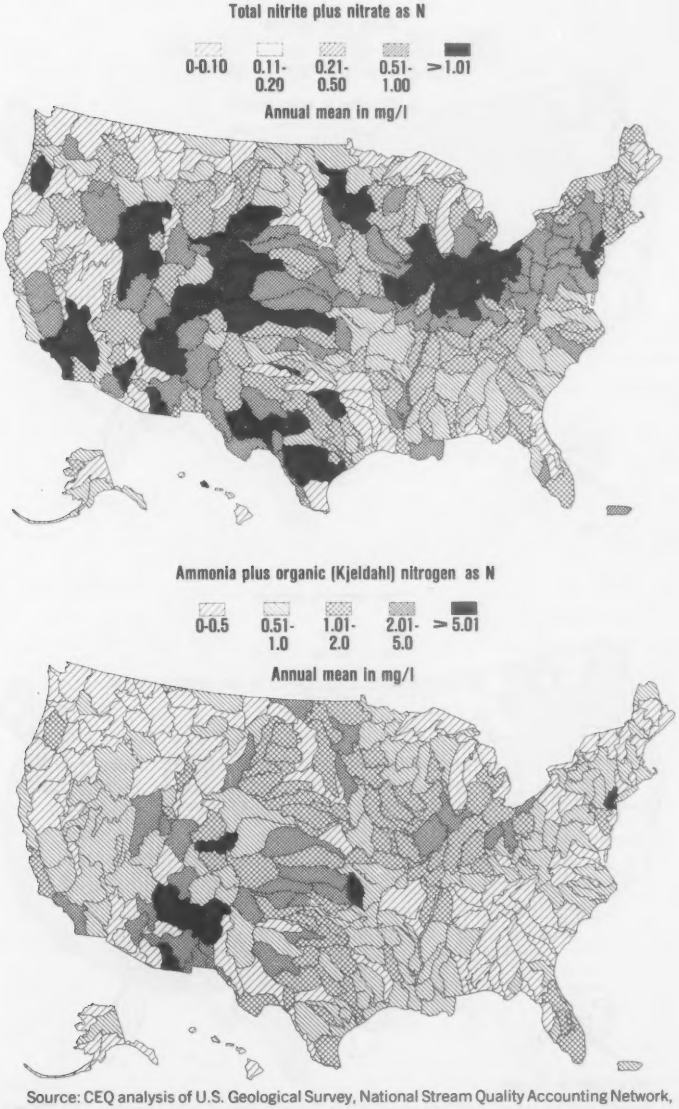
The patterns of high nutrient concentrations reflect the influence of the farm belt; fertilizer and livestock wastes are principal sources of nitrogen and phosphorus. Nutrient levels are also high in urban industrialized regions, such as the Northeast and the Great Lakes, where the common sources are municipal sewage, urban runoff, and industrial wastes.

Major sources of bacterial pollution are improperly treated sewage, sewer overflows, poorly operated septic systems, ships and boats, and livestock. Water bodies with excessive fecal bacterial levels cannot be used for swimming, boating, and fishing because of threat of waterborne disease. Coliform, fecal coliform, and fecal streptococcal bacterial counts are commonly used as the principal indicators of bacterial pollution. Coliform bacteria, though not harmful in themselves, indicate the possible presence of pathogens that are a hazard to health.

There are differences in results from the two reporting systems (the states and NASQAN), but again the overall national patterns are similar. As Figures 2–3 and 2–4 show, the worst bacterial pollution problems are in areas of high human or livestock population, such as the Northeast and the Ohio, lower Missouri, and Mississippi

Figure 2-2

Mean Concentrations of Nitrogen at NASQAN Stations during the 1977 Water Year



Source: CEQ analysis of U.S. Geological Survey, National Stream Quality Accounting Network, data.

Figure 2-3

Basins Affected[1] by Bacteria Problems 1977

From point sources

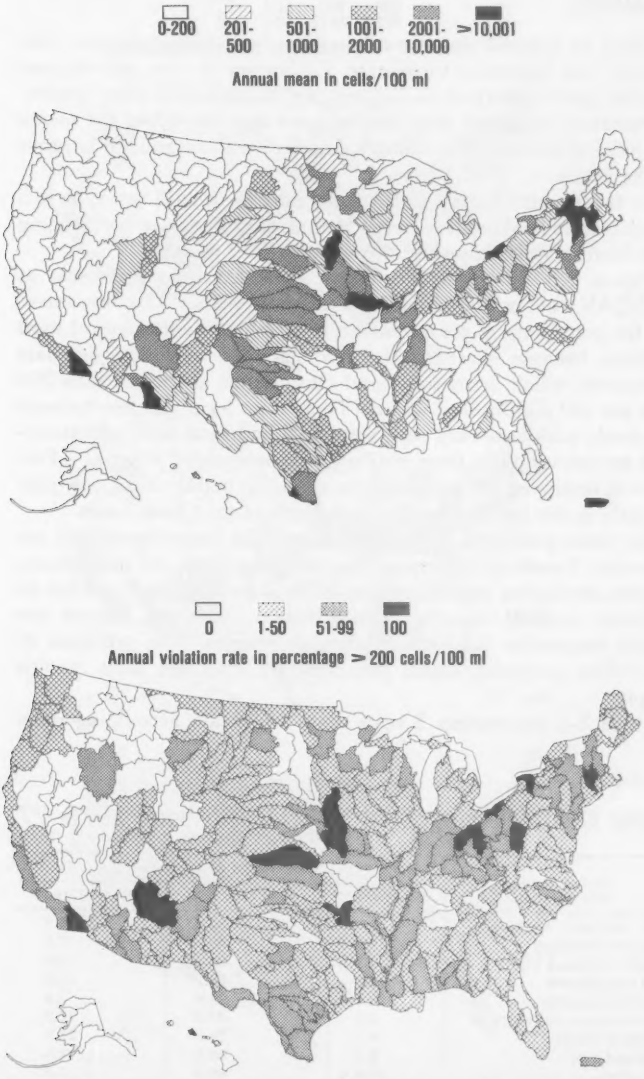
From nonpoint sources

[1]In whole or in part

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, (1978).

Figure 2-4

Fecal Coliform Bacteria at NASQAN Stations during the 1977 Water Year



Source: CEQ analysis of U.S. Geological Survey, National Stream Quality Accounting Network, data.

River basins. Problems are least in the Great Plains, the High Plains, the Northwest, and the Atlantic Coastal Plains, where population densities are generally low.

CHANGES

Many of the pollution control facilities built during the past decade are just beginning to operate. Evaluation of their effectiveness requires good uniform data on plant performance and water quality. Fortunately, improved data networks are now providing the means for judging water quality changes, and they will continue to improve in the future.

So far, uniform water quality data exist for only 3 years, so it is premature to characterize trends definitively. But it is encouraging that bacteria levels improved through the third year.

Figure 2–5 shows fecal coliform levels from measurements at NASQAN stations during the 1975–77 water years. "Violation rates" are the percentage of measurements in which concentrations of fecal coliform bacteria exceeded the recommended maximum for safe swimming, which many states and CEQ define as greater than 200 cells per 100 milliliters of water. (There is no legal uniform national standard; standards vary with water use and local laws and standards sometimes differ from nationally recommended criteria.[6]) Patterns of improvement are apparent in several populous regions, particularly in the industrial urban belt south of the Great Lakes.

For other pollutants, no similar patterns of improvement are yet apparent. Levels of suspended material, nutrients, oil and grease, oxygen-demanding substances, and other materials should decline as pollution control becomes more effective. Nonpoint sources are largely responsible for some of these substances. The problems of controlling nonpoint source pollution are discussed later in this chapter.

Table 2–1 summarizes 3 years' data on stream accounting units

Table 2-1

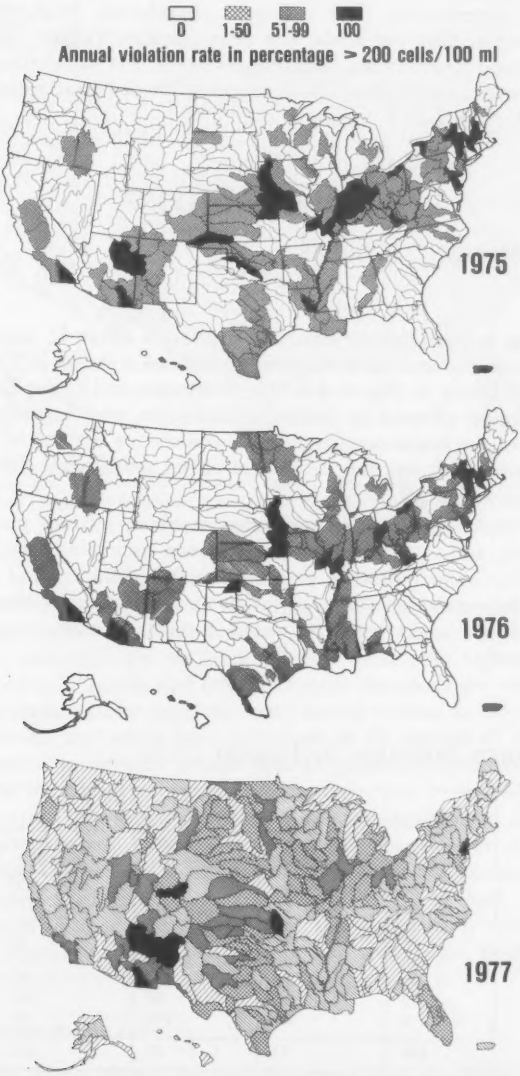
Water Quality Changes[1] at NASQAN Stations 1975–77

Water quality characteristic	Percentage of stations		
	Improved	No change	Deteriorated
Fecal coliform bacteria	7.3	88.9	3.8
Inorganic nitrogen	5.8	86.7	7.5
Organic nitrogen	3.8	83.4	12.8
Total phosphorus	4.3	83.2	12.5
Dissolved oxygen	4.5	92.9	2.6
Fecal streptococci bacteria	1.8	87.3	10.9
Dissolved solids	4.1	74.1	21.8
Dissolved zinc	9.1	86.5	4.4
Total zinc	12.8	85.8	1.4
Phytoplankton	2.0	93.6	4.4

[1] Indications of change tested for statistical significance at the 90 percent level.

Figure 2-5

Fecal Coliform Bacteria at NASQAN Stations during the 1975-77 Water Years



Source: CEQ analysis of U.S. Geological Survey, National Stream Quality Accounting Network, data.

that showed statistically significant change or lack of significant change tested at the 90 percent level, for 10 water quality characteristics. The data indicate that water quality, as measured by fecal coliform bacteria, oxygen, and zinc, has improved at 4–13 percent of the NASQAN stations and that more stations showed improvement than deterioration. For nitrogen, phosphorus, fecal streptococci bacteria, dissolved solids, and phytoplankton (algae), more stations showed deterioration than improvement. For all characteristics measured, most stations (74–94 percent) showed no statistically significant change.

SPECIFIC PROBLEMS AND SOLUTIONS

INDUSTRIAL POINT SOURCES

Impacts

According to state reports industrial discharges affect 72 percent of the basins in the country. A regional breakdown is shown in Table 2–2 and the basins in Figure 2–6. The Northeast and Great Lakes regions are most affected by industrial discharges, with impacts on 88 percent of the basins compared to 65 percent for the rest of the nation. In the Southwest only 23 percent of the basins were affected by industrial discharges.

Oxygen depletion, excessive suspended material, oil and grease, heavy metals, and toxic chemicals are common industrial pollution problems. Particular industries generate thermal pollution and pH problems; for example, discharges of cooling water from electric powerplants can warm receiving waters enough to affect aquatic life significantly.

Table 2-2

Point Source Pollution by Region 1977

Region	Number of basins	Percentage affected[1] by type of source		
		Industrial	Municipal	Combined sewer overflow
Northeast	40	95	95	60
Southeast	47	74	91	17
Great Lakes	41	80	95	37
North Central	35	74	86	6
South Central	30	70	100	0
Southwest	22	23	64	0
Northwest	22	55	73	14
Islands	9	89	100	0
Total	246	72	89	20

[1] In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-6

Basins Affected[1] by Industrial Discharges 1977

[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Specific pollutants from industrial discharges vary with location. In the Northeast, Great Lakes, and North Central regions where heavy industries are centered, effluents containing high concentrations of toxic metals and other industrial chemicals are common. In these regions states reported heavy metals present in 55 percent of the basins and other toxic pollutants in 40 percent of the basins, compared to only 23 percent and 15 percent, respectively, for the rest of the country.

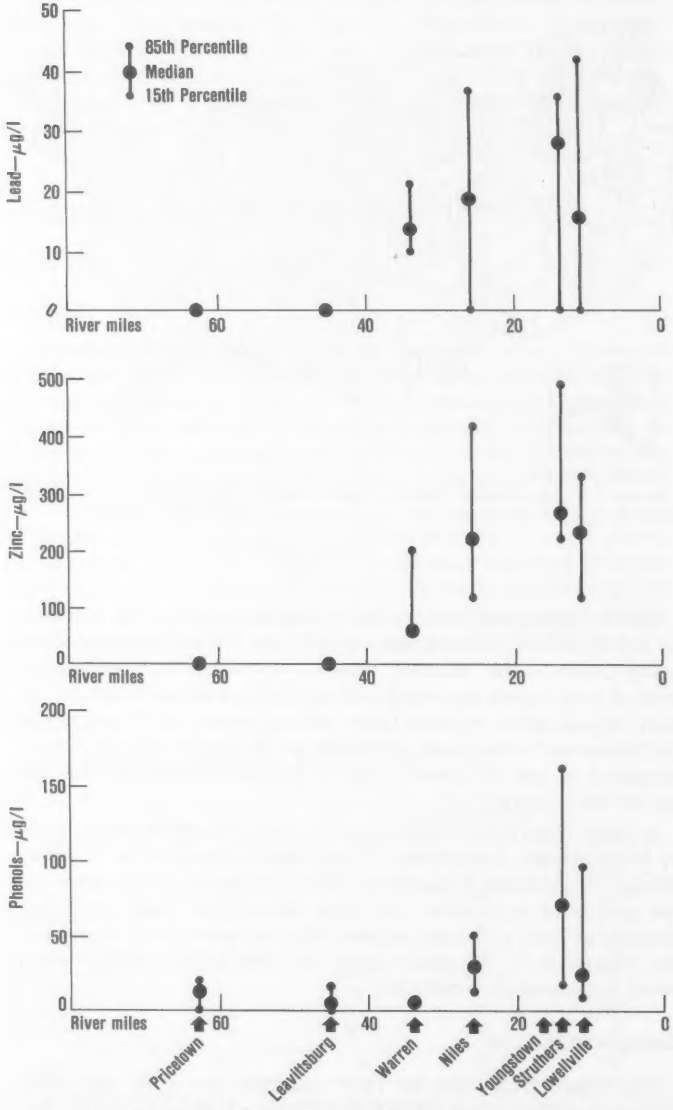
A classic illustration of the effects of heavy industry on water quality is the severe degradation of the Mahoning River as it passes through Warren and Youngstown, Ohio, both major steel centers. In this stretch of river there are large increases in lead, zinc, and phenols, all toxic pollutants at levels that can severely affect aquatic life (Figure 2–7). As plants along the river begin treating waste water, improvement is expected.

Changes in the Law

The Clean Water Act of 1977[7] modified the 1977 and 1983 cleanup deadlines of the 1972 Federal Water Pollution Control Act Amendments,[8] created several new categories of pollutants, and

Figure 2-7

Effects of Industry on the Mahoning River 1973-77



Source: U.S. Environmental Protection Agency analysis of STORET data.

established a new technology-based standard for "conventional" pollutants. Under the new law

- EPA may issue individual extensions from the 1977 deadline to industrial dischargers, up to April 1, 1979, if the discharger shows evidence of a genuine commitment to comply as soon as possible, and the extension will not force extra controls on other sources.[9]
- The Congress published a list of toxic pollutants which dischargers must control by July 1, 1984, by applying the best available control technology.[10] EPA may add to or subtract from the list.[11] (The pollutants are listed in Table 2–3.)
- EPA was directed to publish a list of "conventional pollutants" (including BOD, suspended solids, fecal coliform, and pH) by March 27, 1978. By July 1, 1984, industry must control these discharges using "best conventional pollutant control technology."[12] This is a new standard of control which EPA must specify through effluent limitations guidelines.
- Discharges of pollutants which are neither "toxic" nor "conventional" are called "non-conventional" pollutants. Dischargers must install best available control technology by July 1, 1984, or within 3 years after EPA issues effluent limitations guidelines, whichever is later, but no later than July 1, 1987. EPA may grant variances from this requirement based on economic hardship or, with the concurrence of the state, if an industry can show that the variance will not adversely affect water supplies, shellfish, fish and wildlife, or recreational use of the water or pose an "unacceptable risk to human health or the environment."[13]

Effluent Limitations Guidelines

The 1977 Amendments adopted the toxic pollutants listed in the settlement agreement in *NRDC* v. *Train*[14] (see Table 2–3). In settling the suit, EPA agreed to establish new source performance standards, pretreatment standards, and existing source standards for

Table 2-3

Toxic Pollutants Identified in the Clean Water Act of 1977

Acenaphthene
Acrolein
Acrylonitrile
Aldrin/dieldrin
Antimony and compounds[1]
Arsenic and compounds
Asbestos
Benzene
Benzidine
Beryllium and compounds
Cadmium and compounds

Table 2-3 (continued)

Carbon tetrachloride
Chlordane (technical mixture and metabolites)
Chlorinated benzenes (other than dichlorobenzenes)
Chlorinated ethanes (including 1,2-dichloroethane, 1,1,1-trichloroethane, and hexachloroethane)
Chloroalkyl ethers (chloromethyl, chloroethyl, and mixed ethers)
Chlorinated naphthalene
Chlorinated phenols (other than those listed elsewhere, includes trichlorophenols and chlorinated cresols)
Chloroform
2-chlorophenol
Chromium and compounds
Copper and compounds
Cyanides
DDT and metabolites
Dichlorobenzenes (1,2-, 1,3-, and 1,4-dichlorobenzenes)
Dichlorobenzidine
Dichloroethylenes (1,1- and 1,2-dichloroethylene)
2,4-dichlorophenol
Dichloropropane and dichloropropene
2,4-dimethylphenol
Dinitrotoluene
Diphenylhydrazine
Endosulfan and metabolites
Endrin and metabolites
Ethylbenzene
Fluoranthene
Haloethers (other than those listed elsewhere, includes chlorophenylphenyl ethers, bromophenylphenyl ether, bis(dischloroisopropyl) ether, bis-(chloroethoxy) methane, and polychlorinated diphenyl ethers)
Halomethanes (other than those listed elsewhere, includes methylene chloride, methylchloride, methylbromide, bromoform, dichlorobromomethane, trichlorofluoromethane, dichlorodifluoromethane)
Heptachlor and metabolites
Hexachlorobutadiene
Hexachlorocyclohexane (all isomers)
Hexachlorocyclopentadiene
Isophorone
Lead and compounds
Mercury and compounds
Naphthalene
Nickel and compounds
Nitrobenzene
Nitrophenols (including 2,4-dinitrophenol, dinitrocresol)
Nitrosamines
Pentachlorophenol
Phenol
Phthalate esters
Polychlorinated biphenyls (PCBs)
Polynuclear aromatic hydrocarbons (including benzanthracenes, benzopyrenes, benzofluoranthene, chrysenes, dibenzanthracenes, and indenopyranes)
Selenium and compounds
Silver and compounds
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)
Tetrachloroethylene
Thallium and compounds
Toluene
Toxaphene
Trichloroethylene
Vinyl chloride
Zinc and compounds

[1] "Compounds" includes organic and inorganic compounds.

Source: U.S. Congress, House, Committee on Public Works and Transportation, *Data Relating to H.R. 3199 (Clean Water Act of 1977)*, Print No. 95-30, 95th Cong., 1st Sess. (Washington, D.C.: U.S. Government Printing Office, 1977), pp. 3-4.

65 classes of toxic pollutants for 21 industries. The Congress also eliminated provisions in the 1972 law which allowed EPA to grant economic variances from toxic pollutant standards.

EPA faces a formidable task in developing and enforcing new effluent limits for toxic pollutants. It must collect and analyze extensive data on the sources and amounts of existing discharges, on control technologies and their costs, and on the likely economic impact on each of the 21 industries of alternative levels of control. After establishing standards, EPA regional offices and the states must reissue permits to most major dischargers to incorporate the new requirements, then enforce the permits to achieve compliance by 1984.

Table 2–4 lists the effluent limitations guidelines, pretreatment standards, and new source standards adopted, proposed, and planned as of August 1978.

Pretreatment

Studies by EPA[15] have estimated that up to 25 percent of the waste received by municipal sewage treatment plants is from industrial sources. A number of the pollutants discharged by industrial users of municipal plants are substances for which there is evidence of carcinogenicity, mutagenicity, and/or teratogenicity. Others are known to have acute toxic effects on humans or aquatic organisms at sufficiently high concentrations. Many of the toxic pollutants are persistent in the environment and some bioaccumulate and enter food chains. When industrial pollutants enter muncipal sewers, they can create three types of problems:

- Interference—The most immediate impact of these pollutants can be on the operation of the sewage treatment plant. Discharges of high volumes or concentrations of certain pollutants can inhibit or interfere with the proper operation of the biological treatment system in the plants.
- Sludge management—Toxic pollutants, partially treated by a municipal sewage treatment plant, can enter the plant's sludge. Sludge contaminated wtih toxic materials can be unusable as a soil conditioner. Improper handling of sludges contaminated with metals and other toxic pollutants can result in uptake of these pollutants by crops in the human food chain or in leaching of these pollutants into ground water (currently the source of approximately 50 percent of the nation's drinking water) as well as surface waters.
- Pass-through—Toxic pollutants pass through sewage plants in quantities and concentrations that can be harmful to the environment and that would be unacceptable under federal, state, and local regulations dealing with industrial discharges directly to receiving waters. Toxic industrial pollutants which pass through the plant can prevent reuse of municipal waste waters and the productive recycling of organic matter and nutrients in land treatment systems. The pass-through of toxic industrial pollu-

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Table 2-4

Interim and Final Industry Effluent Standards

Industrial category	Number of subcategories	Date proposed	Date promulgated
Group I Phase I			
Cooling water intake structures	1	12/13/73	4/26/76
Dairy products processing	11	1/14/74	5/28/74
Grain mills	6	10/11/73	3/20/74
Canned and preserved fruits and vegetables	5	11/30/73	3/21/74
Canned and preserved seafood processing	14	1/3/74	6/26/74
Sugar processing (beet and cane)	2	10/29/73	3/20/74
Textile industry	7	2/5/74	7/5/74
Beet sugar	1	8/22/73	1/31/74
Cement manufacturing	3	9/7/73	2/20/74
Feedlots	2	7/7/73	2/14/74
Electroplating	1	12/7/73	3/28/74
Organic chemicals	3	12/7/73	4/25/74
Inorganic chemicals	22	10/11/73	3/12/74
Plastics and synthetics	13	11/9/73	4/4/74
Soap and detergent manufacturing	19	12/14/73	4/12/74
Fertilizer manufacturing	5	12/26/73	4/8/74
Petroleum refining	5	12/14/73	5/9/74
Iron and steel manufacturing	12	2/19/74	6/28/74
Nonferrous metals manufacturing	3	12/4/73	4/8/74
Phosphate manufacturing	3	10/7/73	2/20/74
Steam electric power generating	4	3/4/74	10/8/74
Ferroalloy manufacturing	3	10/18/73	2/22/74
Leather tanning and finishing	6	4/8/73	4/9/74
Fiberglass	1	8/22/73	1/22/74
Glass manufacturing	6	9/7/73	2/14/74
Asbestos manufacturing	7	10/5/73	2/26/74
Rubber processing	4	10/11/73	2/21/74
Timber products processing	8	12/20/73	4/18/74
Pulp, paper, and paperboard	5	2/6/74	5/29/74
Builders paper and roofing felt	1	12/17/73	5/9/74
Meat products and rendering	4	10/30/73	2/28/74
Poultry	5	4/24/75	4/26/76
Group I Phase II			
Cooling water intake structures			
Grain mills	4	9/17/74	1/3/75
Canned and preserved fruits and vegetables	51	[1]10/21/75	4/16/76
Canned and preserved seafood processing	19	[1]1/30/75	12/1/75
Sugar process	5	[2]2/27/75	
Electroplating	3	[4]4/25/75	
Organic chemicals	4	[1]1/5/76	
Inorganic chemicals	41	[5]5/22/75	
Plastics and synthetics	11	9/20/74	1/23/75
Fertilizer manufacturing	2	10/7/74	1/14/75
Petroleum refining			
Iron and steel manufacturing	23	[3]3/29/76	
Nonferrous metals manufacturing	5	[2]2/27/75	12/15/76
Phosphate manufacturing	3	[1]1/27/75	
Ferroalloy manufacturing	5	[2]2/24/75	
Glass manufacturing	6	8/21/74	1/16/75
Asbestos manufacturing	4	8/29/74	1/9/75
Rubber processing	7	8/23/74	1/10/75
Timber products processing	7	[8]8/26/74	1/16/75
Pulp, paper, and paperboard	10	2/19/76	1/6/77
Meat products and rendering	6	8/28/74	1/3/75
Poultry			

Table 2-4 (continued)

Group II			
Cooling water intake structures			
Machinery and mechanical products			
Timber products processing	4	11/14/74	6/2/75
Coal mining	4	[1]10/17/75	
Petroleum and gas extraction	4	[1]9/15/75	
Mineral mining and processing	17	[1]10/16/75	
Water supply	15		
Miscellaneous foods and beverages processing	12		
Pharmaceutical industry	5		
Ore mining and dressing	7	[1]11/6/75	7/11/78
Transportation industries	7		
Fish hatcheries and farms	3		
Paving and roofing materials (tars and asphalt)	4	[1]1/10/75	7/24/75
Auto and other laundries	9		
Converted paper products	1		
Paint formulation	1	[1]2/26/75	7/28/75
Ink formulation	1	[1]2/26/75	7/28/75
Printing	17		
Steam supply	2		
Pretreatment for oil and grease			
Clay and gypsum	12		
Concrete products	2		
Shore receptor and bulk terminals	4		
Gum and wood chemicals industries	6	[1]5/18/76	
Pesticides and agricultural chemicals	5	[1]11/1/76	4/25/78
Adhesives and sealants industries	6		
Explosives industries	4	[1]3/9/76	
Carbon black industries	4	[1]5/18/76	1/9/78
Photographic point source category	6	[1]7/14/76	
Hospitals	4	[1]5/6/76	
Battery manufacturing	13		
Edible oils	2		
Plastic processing	5		
Foundries	9		
Coil coating	3		
Porcelain enamel	5		
Aluminum and aluminum alloy products	6		
Copper and copper alloy products	6		
Electronics	18		
Shipbuilding	1		

[1] Interim final guidelines.

Source: U.S. Environmental Protection Agency, Office of Water and Hazardous Substances.

tants can also prevent the attainment of water quality standards and increase the cost to consumers of treating drinking water.

Pollutants which cause or have the potential to cause any of these problems when discharged to a municipal sewage treatment plant require pretreatment prior to discharge into a municipal sewer system.

EPA has developed a national pretreatment strategy and a newly revised regulation which provide for national pretreatment standards.[16] The regulation includes general discharge prohibitions applicable to nondomestic wastes into municipal plants and provides for effluent standards for specific industries. These standards will be

issued by EPA in separate regulations for 21 industry categories over the next 2 years.

Within 3 years of issuance or reissuance of a National Pollutant Discharge Elimination System (NPDES) permit for each municipal sewage treatment plant (but in no case later than July 1, 1983), a local pretreatment enforcement program will be required as a condition of the permit. A local pretreatment program will be required if the municipality's sewage system has a design flow of more than 5 million gallons per day and receives wastes from sources subject to categorical pretreatment standards. When a local pretreatment program is developed, the municipality will be responsible for enforcement of the national pretreatment standards as well as any local or state standards. Funding to assist municipalities in developing pretreatment programs will be available through Section 201 (construction grants) and Section 208 (areawide and state planning grants).

Most of the industrial facilities potentially subject to categorical pretreatment standards discharge to approximately 2,500 of the nation's more than 13,000 municipal plants.[17] The majority of these 2,500 plants have either primary or secondary treatment; the remainder may provide additional treatment and may remove significant portions of industrial waste that they receive. To prevent industrial users from having to install unnecessary treatment, municipalities are allowed to give credit for the removal provided by the municipal plant. EPA and states approved to administer the NPDES program will enforce the national pretreatment standards where local governments do not develop a pretreatment program and assume enforcement responsibility.

The pretreatment program is expected to require compliance with categorical pretreatment standards by up to 20,000 dischargers in 1980 and potentially as many as 38,000–55,000 by 1983.[18] Approximately 600 municipalities[19] will be required to develop a local pretreatment enforcement program, and others may elect to do so in order to modify categorical pretreatment standards.

Compliance and Enforcement

Regulating point sources under the Clean Water Act is a state and federal enterprise.[20] States with qualified programs can take over from EPA administration of the National Pollutant Discharge Elimination System, the permit program created by the Act. As of January 1978, 30 states are administering the program, shown in Table 2–5. In the other states, EPA issues and enforces permits, but the states frequently participate in some respects. In Maine, Texas, and Massachusetts, for example, EPA has signed cooperative agreements with state pollution control agencies for them to assist in permit reviews, inspections, and other activities.[21]

By June 30, 1978, EPA and the states had issued permits to 7,706 major and 44,811 minor dischargers, covering 98 percent and 69 percent of these categories, respectively, shown in Table 2–6. Permits typically include effluent limitations, a schedule for achieving them, and monitoring and reporting requirements.

Table 2-5

Status of Approval for States To Administer Their Own NPDES Permits, January 1978

Approved	Not approved
California	Alabama
Colorado	Alaska
Connecticut	Arizona
Delaware	Arkansas
Georgia	Florida
Hawaii	Idaho
Indiana	Iowa
Illinois	Kentucky
Kansas	Louisiana
Maryland	Maine
Michigan	Massachusetts
Minnesota	New Hampshire
Mississippi	New Jersey
Missouri	New Mexico
Montana	Oklahoma
Nebraska	Pennsylvania
Nevada	Rhode Island
New York	South Dakota
North Carolina	Texas
North Dakota	Utah
Ohio	West Virginia
Oregon	
South Carolina	
Tennessee	
Vermont	
Virginia	
Washington	
Wisconsin	
Wyoming	

Source: U.S. Environmental Protection Agency, Office of Water Enforcement, "Enforcement Progress Report for FY 1977," draft, March 1978.

Table 2-6

Status of NPDES Permits, June 1978

Permits	Issued	Applied	Percentage issued
Major			
Municipal	3,728	3,778	99
Nonmunicipal	3,719	3,798	98
Public-private	11	13	85
Federal	214	228	94
State	33	33	100
Unspecified	1	6	17
Total	7,706	7,856	98
Minor			
Municipal (public)	14,148	17,181	82
Nonmunicipal (private)	25,423	39,662	64
Public-private	1,526	2,113	72
Federal	1,677	2,090	80
State	1,217	1,470	83
Unspecified	820	1,964	42
Total	44,811	64,480	69

Source: U.S. Environmental Protection Agency, Office of Water Enforcement.

July 1, 1977, was the statutory deadline for industrial dischargers to meet effluent limitations based on "best practicable control technology" unless other federal or state regulations require stricter controls.[22] Approximately 81 percent of the 3,798 major industrial dischargers complied on time; 724 did not. By February 1978, the number of noncompliers was 627.[23] EPA targeted the worst 300 offenders for civil or criminal enforcement actions.

An important change in EPA enforcement is a new "penalty policy." EPA will ask courts to impose penalties on delinquent sources in amounts which equal at least the economic savings which accrued to each discharger since July 1, 1977. This economics-based approach to enforcement is similar to a program established several years ago in Connecticut.[24]

In fiscal year 1977, EPA and the states conducted 6,880 sampling inspections and 15,639 nonsampling inspections. EPA issued 1,128 administrative enforcement orders, referred 115 cases to the Department of Justice, and collected $15.6 million in penalties and fines for noncompliance.

MUNICIPAL POINT SOURCES

Impacts

State reports noted adverse effects on water quality from municipal discharges in 89 percent of the basins in the country. Basins affected are shown in Figure 2–8 (and are summarized by region in Table 2–2). As expected, the more populous regions generally have more basins that are affected. Yet even in the sparsely populated Southwest, 64 percent reported pollution from municipal discharges. Most of the pollution was caused by inadequate treatment or overloaded treatment plants. The states expect that much of the problem will be resolved as federally funded treatment facilities are constructed. As discussed below, however, operation of these plants could be a significant problem.

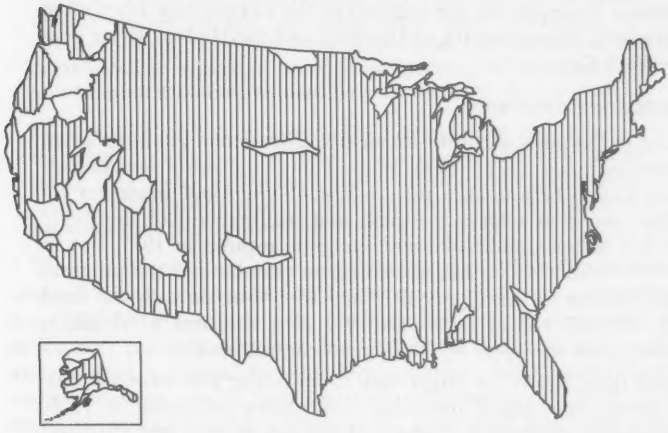
The pollutants most often observed at unacceptable levels in municipal discharges are fecal coliform bacteria, oxygen-demanding materials, and phosphorus and nitrogen. Municipal discharges can also contain an excess of suspended sediments or dissolved solids as well as heavy metals and toxic organic compounds.

Combined sewer overflows can severely degrade water quality. When rainfall runoff is added to normal sewage flows in systems with combined storm and sanitary sewers, sewage treatment plants generally cannot handle the flow, and much of it bypasses treatment. Combined overflow discharges contain bacteria, nutrients, oxygen-demanding loads, suspended sediment, heavy metals, and oil and grease.

Combined sewer systems are often found in the older cities of the Northeast and Great Lakes region, as shown in Figure 2–9. Nearly one-half the basins in those regions are affected by combined over-

Figure 2-8

Basins Affected[1] by Municipal Discharges 1977

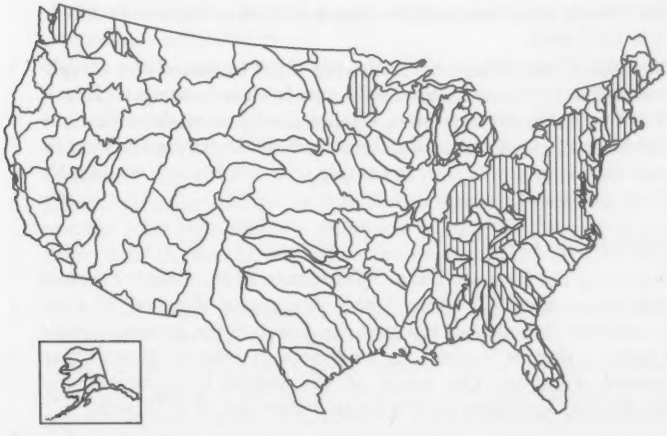


[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-9

Basins Affected[1] by Combined Sewer Overflows 1977



[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

flows, compared with only 8 percent for the rest of the country. In some major rivers of the Northeast and Great Lakes, combined sewer overflows were the cause of the most serious water quality problems. Examples are the segment of the Connecticut River from Springfield, Massachusetts, to Hartford and the Hudson River near New York City.

Grants and Compliance

One of the purposes of the municipal construction grants program authorized by the 1972 Federal Water Pollution Control Act Amendments was to help finance the backlog of municipal treatment facilities needed to achieve the goals and requirements of the Act.[25] The $18 billion municipal grants program expired in 1977, but in the 1977 Clean Water Act, the Congress reauthorized the program at $4.5 billion for fiscal year 1978 and $5 billion annually for fiscal years 1979–82. During fiscal year 1977 EPA obligated $7.17 billion in new grants and spent $3.5 billion on current projects.

Both these figures are larger than in any other year since the federal government began providing construction assistance in 1956. Outlays were expected to continue at this rate in fiscal year 1978 and to increase to $4.4 billion in fiscal year 1979. As of June 1978, 4,281 projects had been completed under the 1972 Amendments and 9,972 were active.[26]

Despite this level of grants activity, 2,114 (58 percent) of all major municipal dischargers did not meet the July 1, 1977, secondary treatment deadline.[27] Much of the lag is caused by impoundments of federal funds in the early years of the program, delays in approving grants, or delays in construction not related to impoundment or grants. Nearly all municipalities expect federal assistance in reaching the 1977 goal.

The 1977 Clean Water Act authorizes EPA to extend the compliance deadline for municipalities on a case-by-case basis up to July 1, 1983.[28] To qualify for extension, a municipality must show that unavailability of federal funds is the principal reason for delay. Municipalities that were simply slow to comply with the law are not eligible for compliance extensions.

Changes in the Law

Improving the Environmental Effectiveness of the Grants Program
In debates on the 1977 Clean Water Act, many Members of Congress expressed serious concern over the direction the grants program had taken—whether it had been used more to promote growth than to control pollution. The report of the Senate Environment and Public Works Committee on the Clean Water Act of 1977 said:

> Half of the 18 billion of federal dollars was impounded early in the program. Collector sewers, interceptor sewers, and treatment plants were approved even though their primary purpose was to meet new growth needs. Secondary treatment was de-

fined without recognition of reclaiming and recycling alternatives.

Many of the nation's largest cities such as Philadelphia, New York, St. Louis, and San Francisco still discharge raw or inadequately treated sewage into rivers, lakes, bays, and oceans. At the same time, oversized interceptors and new collectors are constructed in suburban areas in anticipation of development, and treatment plants are sized to accommodate that growth.

Small communities are overwhelmed by complex requirements, the result of which is the construction of conventional systems which they do not understand how to operate and cannot afford to run. Alternatives exist but are not encouraged by the institutions and personnel involved.[29]

These same concerns were expressed by top EPA officials who pledged reform and innovation in the grants program even before the Congress changed it.[30] In October 1977, EPA announced a major new policy emphasizing land treatment of municipal waste and released a manual to assist local planners and consultants to make maximum use of land treatment alternatives. In 1972, 571 municipalities serving 6.6 million people were using land treatment, compared to 304 municipalities serving 0.9 million in 1940.[31] Table 2–7 lists examples of successful land treatment applications. The Administration also supported amendments to place new emphasis on water conservation and recycling and on alternative treatment plants.[32] The Congress largely adopted the Administration's recommendations, making the following changes in the law:

- After fiscal year 1978, EPA may not make grants for treatment works unless the municipality demonstrates that innovative and alternative waste water treatment techniques have been fully studied and evaluated.[33]
- EPA is authorized to fund 85 percent (instead of the normal 75 percent) of the cost of constructing treatment plants which use innovative waste water techniques; this extra 10 percent is available for fiscal years 1979–81. The funds are set aside from regular allotments to states.[34]
- EPA may make grants for innovative technology even if it is not the most cost-effective approach so long as the cost is not more than 15 percent more than the most cost-effective alternative.[35]
- EPA must adopt guidelines for identifying and evaluating innovative and alternative treatment systems by June 27, 1978.[36]
- EPA may provide grants for the construction of privately owned treatment plants if public ownership is not feasible and if the private service is more cost effective than collection and central treatment. This provision applies to alternative or unconventional treatment plants for individual houses or clusters of residences. Secondary treatment package plants do not qualify.[37]

Table 2-7

Selected Land Treatment Systems

Location	Average flow (million gallons per day)	Average annual application rate (feet per year)	Degree of preapplication treatment	Application technique	Number of years in operation
Slow rate					
Pleasanton, California	1.4	8.5	Secondary (plus aerated holding ponds)	Sprinkler (portable pipe)	20
Walla Walla, Washington					
Industrial	2.1	1.7	Aeration	Sprinkler (buried pipe)	5
Municipal	6.8	—	Secondary	Sprinkler and surface (ridge and furrow)	78
Bakersfield, California (existing system)	14.7	6.9	Primary	Surface (border strip and ridge and furrow)	38
San Angelo, Texas	5.8	10.3	Primary	Surface (border strip)	18
Muskegon, Michigan	28.5	6.0	Aerated lagoons	Springler (center pivot)	3
St. Charles, Maryland	0.6	10	Aerated lagoons	Sprinkler (surface pipe)	12
Rapid infiltration					
Phoenix, Arizona	13	364	Secondary	Surface (basin flooding)	3
Lake George, New York	0.7	140	Secondary	Surface (basin flooding)	38
Fort Devens, Massachusetts	1.3	94	Primary	Surface (basin flooding)	35
Overland flow					
Pauls Valley, Oklahoma	0.2	19-45	Raw (screened) and oxidation lagoon	Surface (bubbling orifice) and sprinkler (fixed and rotating nozzles)	2
Paris, Texas (industrial)	4.2	5.2	Raw (degreased and screened)	Sprinkler (buried pipe)	13

1 million gallons per day = 43.8 liters per second

1 foot per year = 0.305 meters per year

Source: U.S. Environmental Protection Agency, *Process Design Manual for Land Treatment of Municipal Wastewater*, EPA 625/1–77–008 (Washington, D.C.: U.S. Government Printing Office, 1977), p. 7–1.

- The Act sets aside 4 percent of the funds allotted to any state whose rural population is 25 percent or more of the total state population. These reserve funds are to be used only for alternative or unconventional systems for communities of 3,500 or less or for highly dispersed sections of larger communities.[38]
- In determining the amount of reserve capacity for a treatment plant, EPA must take into account efforts to reduce total flow and unnecessary water consumption.[39]

EPA adopted interim final regulations in April 1978 and proposed other revisions in the grants regulations[40] to implement the 1977 Amendments. A controversial proposal requiring local population projections used to determine reserve capacity to match Commerce Department projections would reduce the chance that municipalities could fund excess capacity through unrealistic growth forecasts.[41]

Citizen Participation An EPA survey has found that public participation in planning treatment facilities can force consideration of new alternatives and reduce project costs. The initial survey of 13 sewage treatment projects showed that active citizen participation contributed to projected taxpayer savings of over $100 million.

Water Quality Water quality is gradually improving as additional municipal and industrial treatment plants begin operating. Table 2–8 summarizes the effects on water quality downstream of 11 cities where major treatment projects were completed between 1967 and 1975. Water quality improved in eight municipalities and did not change in two. Several recent studies suggest that if existing plants are funded in some older cities, EPA could spend millions of dollars for municipal sewage treatment plants that would do little to improve water quality. The studies underscore the need for close tie-ins between water quality management and municipal facility planning.[42]

In Boston, a waste water management plan proposes expansion and upgrading of two primary treatment plants, construction of several advanced treatment plants, construction of holding ponds for temporary detention and chlorination of combined sewer overflows, and various system repairs. The preliminary case study, conducted for four federal agencies to learn from the Boston experience, finds that water quality improvements from an investment of over $850 million (1975 dollars) would probably range from zero to very small.[43] The major reason is that pollution in Boston Harbor and its tributaries is primarily from combined sewer overflows and stormwater, and the plan barely addresses these two problems.

A General Accounting Office study[44] tells a similar story for St. Louis. There, planned secondary treatment investments of $216 million for two plants are expected to produce much less water quality improvement than if the funds were applied to combined sewer overflows.

Improving the Management of the Grants Program EPA has encouraged states to assume more responsibility for managing the

Table 2-8

Water Quality Downstream of 10 Major Municipal Water Treatment Plants Completed 1967–75

City	Receiving water	Effective date	Flow	Fecal coliform bacteria	Dissolved oxygen	Turbidity	Oxygen demand	Ammonia	Phosphorus	Overall
Albany, New York	Hudson River	3/31/75					NC	NC	I	I
Auburn, Maine	Androscoggin River	3/11/74	NC	I	NC				I	I
Detroit, Michigan	Detroit River	11/30/73		NC	I			NC	I	I
Jackson, Michigan	Grand River	5/31/73	NC	NC	NC	NC	I	I	I	I
Little Rock, Arkansas	Arkansas River	12/31/73	I	I	I		I		I	I
Naugatuck, Connecticut	Naugatuck River	4/30/75	I		I		I		I	I
Oakdale, Louisiana	Calcasieu River	1/1/73			I	NC				I
Sacramento, California	Sacramento River	12/31/72	NC		NC	NC				NC
Topeka, Kansas	Kansas River	12/31/70	I	NC	NC	NC	NC			NC
Winston-Salem, North Carolina	Yadkin River	5/31/73	I	I	I					I

NC = No change
I = Improvement (increase for flow)
D = Degradation (decrease for flow)

Source: U.S. Environmental Protection Agency, Office of Water Program Operations, 1977.

grants program. Thirty-seven states are certified to review the plans for proposed treatment facilities, to approve or change orders during construction, or to review operation and maintenance plans. California already manages the full program, from approval of design to approval of selection among bidders through disbursement of funds. Maryland and Michigan have been approved for full management.[45]

The Congress supported EPA efforts to delegate responsibilities to the states by reserving up to 2 percent of a state's allotment (but no less than $400,000) for the state to use in administering its water quality program. As a further condition for obtaining grants, states must "demonstrate a commitment" to developing the capability to advise small communities on cost-effective treatment alternatives.[46]

In order to increase management oversight during the construction phase of treatment facilities, EPA reached agreement with the Army Corps of Engineers for the Corps to assist in construction supervision. Involvement of the Corps was to begin on a pilot basis in 1978. The Corps will review plans and specifications and inspect sewage treatment plants under construction to ensure that good engineering practices are proposed and used.

DISCHARGES FROM FEDERAL FACILITIES

Compliance with requirements for treatment of point source discharges by federal facilities has been less than compliance by industry; 151 (66 percent) of the 228 major federal dischargers complied with the 1977 deadline, compared to approximately 84 percent of major industrial dischargers.[47] The Administration's budget request for fiscal year 1979 included $484 million, which is expected to enable these federal sources to comply. In addition, the President issued an Executive order requiring that federal installations meet applicable federal, state, and local environmental requirements.

The Congress also acted to make federal facilities more responsive to state and local requirements. Taking note of the Supreme Court's decision in *California* v. *Train*,[48] the Congress changed the law to require that federal agencies comply with all federal, state, interstate, and local requirements, including procedural requirements, substantive standards, service charges, and orders and penalties.[49]

OCEAN DISCHARGES

Modification of Secondary Treatment Requirements

The 1977 Amendments to the Clean Water Act allow municipalities to apply to EPA for modification of secondary treatment requirements for publicly owned treatment works. Section 301(h) provides that the EPA Administrator may issue an NPDES permit modifying effluent limitations for biological oxygen demand, sus-

pended solids, and pH when the applicant discharges into certain ocean and estuarine waters.[50]

A number of west coast municipalities have applied for modified permits for municipal ocean discharges on the grounds that secondary treatment is unnecessary to maintain water quality in deep ocean water. The municipalities argue that in the deep ocean wastes are rapidly aerated and dispersed by strong currents and tidal action. Consequently, the same levels of pollutant reduction required in freshwater areas on which pollutant standards are based are not necessary for the deep ocean. The National Commission on Water Quality found that under some conditions (depending on currents, depth of outfall, etc.), secondary treatment of certain ocean discharges might not be necessary.[51] To qualify for a modified permit, the applicant must comply with eight statutory criteria designed to ensure that the modification will not result in any increase in the discharge of toxic pollutants or otherwise impair the integrity of receiving waters.

The eight criteria are that: applicants demonstrate that there is an applicable state water quality standard specific to the pollutant for which the modification of the requirements of secondary treatment is requested; dischargers can demonstrate that their less-than-secondary-treated discharge will not interfere with the attainment and maintenance of water quality which is necessary to protect public water supplies; the discharger can demonstrate that its discharge will not interfere with the attainment and maintenance of water quality which allows for recreational activities; a monitoring system has been established to measure the impact of the discharge on a representative sample of the aquatic biota in the receiving water; the discharge will not result in increased pollution control requirements of other point or nonpoint sources; the discharger has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into its facility, to the extent practicable; there will be no new or substantially increased discharges of the pollutant to which the modification applies above the volume of discharge specified in the modified permit; and any Title II funds available to the publicly owned treatment plant will be used to achieve the degree of effluent reduction required by Sections 201(b) and 201(g)(2)(A) of the Act or to carry out the requirements of Section 301(h), including construction of monitoring facilities.

These modified permits are available only for existing discharges. EPA expects several hundred applications before the September 24, 1978, deadline. Any waivers granted would be limited to 5 years unless renewed. They will require special monitoring and will allow no new or substantially increased discharges. Industrial pretreatment and removal of toxics will be required.

Ocean Dumping [52]

Although the Marine Protection, Research, and Sanctuaries Act

prohibits the EPA Administrator from issuing any permit or permit renewal for the dumping of sewage sludge into ocean waters after December 31, 1981, the ocean dumping of waste materials remains a serious pollution problem. The purpose of the Act is to prevent or limit strictly the ocean dumping of any material which would adversely affect human health, welfare, and amenities, the marine environment, ecological systems, or economic potential.

Title I of the Act establishes a permit system and assigns its administration to EPA and the Corps of Engineers. Under Title I the U.S. Coast Guard is given the responsibility to ensure that the dumping occurs under a valid permit and at the location and in the manner specified within the permit.

During 1977, there was a 12 percent drop (from 8,327,000 tons to 7,401,600 tons) from 1976 levels in ocean dumping of waste materials other than dredged spoils. Nearly 70 percent (5,134,000 tons) of the total amount dumped was sewage sludge from the northeast coast. Industrial waste dumping during 1977 dropped to two-thirds of that dumped during 1976 (from 2,733,500 to 1,843,800 tons), and by the end of 1977 the last permittee having an interim permit to dump in the Gulf of Mexico had ceased direct dumping of wastes. During 1977, 20 permittees were phased out of ocean dumping, increasing the number of permits denied or phased out to 168 since the inception of the EPA permit program. The largest number was in the New York EPA Region, where 7 industrial dumpers and 11 municipal dumpers were phased out.

In 1977 the Coast Guard referred to EPA Regional Offices 35 cases involving 226 alleged violations of dumping permits, which included 126 dumpings at an improper dispersal rate and 77 for failure to provide proper notification. The most significant enforcement action came on May 17, 1978, when the Philadelphia Regional Administrator announced that the city of Philadelphia had committed 32 violations of its annual permit between June 1976 and June 1977. The city was fined $225,000, although a maximum penalty of $1.4 million could have been imposed.

The Corps of Engineers estimates that 93,780,000 tons of dredged materials was dumped in ocean waters in 1976—almost 13 times the amount of other materials so disposed of. Although the level is down 25 percent from 1975 and 34 percent from 1974, the long-term trend in the amount of dredged material being disposed of annually is not decreasing. Weather conditions in the Mississippi River drainage area have fluctuated significantly over the past several years, and a major federal project in the Pacific Ocean involved over 9 million cubic yards in 1975—both significantly affected the total amount dumped. If the data were normalized for these unusual conditions, it is reasonable to assume that in an average year the United States disposes of approximately 100 million tons of dredged materials into ocean waters.

The 93.8 million tons of dredged materials disposed of by the Corps was dredged from 71 project locations and placed in 63

disposal sites. Maintenance dredging accounted for 89 percent and 11 percent was generated from new work.

More than 90 percent of the ocean-dumped dredged materials were deposited off the coasts of only nine states in 1976, and six coastal states had no ocean disposal activity. More than 55 percent of the materials were dumped 3 miles or more offshore.

Most dredged materials are composed primarily of natural sediment from upland; their disposal need not create any particular environmental problem. However, pollutants added to the natural sediments by municipal and industrial discharges to harbor areas can create severe environmental stresses and consequent problems in handling and disposal of dredged materials. Extreme examples include Kepone in James River muds and PCBs in Hudson River deposits. Organic substances in dredged materials from urban runoff, drainage channels, and sewers may cause oxygen depletion and damage to benthic organisms in disposal areas.

While congressionally authorized federal projects do not require a Corps permit, Section 103 of the 1977 Amendments allows the Corps to issue permits to the public and to federal, state, and local agencies for the ocean disposal of dredged materials. In 1976, approximately 2.2 million tons were disposed of under this authority; this figure represents only 2.3 percent of the total dredged materials dumped in the ocean. In 1976 there were 32 active Section 103 permits which resulted in the disposal of dredged materials at 13 ocean sites—all outside the 3-mile limit. Although Section 103 permit activity is expected to increase slightly, it is not expected to exceed 10 percent of the total dredged materials disposed of in the ocean. Dredged material from congressionally authorized Corps projects will continue to dominate.

NONPOINT SOURCES

A long list of human activities causes nonpoint pollution—farming, lumbering, pesticides and fertilizers applied to crops and lawns, disposal of waters on or under the ground, construction, and mining. Nonpoint sources are especially difficult to control. Indeed, they may stand in the way of achieving the 1983 goals in some areas.

The first 109 areawide planning agencies established under Section 208 of the 1972 Act identified urban storm water and agricultural and construction runoff as principal contributors to their water quality problems.[53] EPA's 1975 national inventory of water quality indicated that nonpoint pollution problems would make it impossible to attain "fishable" and "swimmable" waters by 1983.[54] For example, Montana reported in 1977 that 4,000 miles of its streams could not meet 1983 goals; the reason for more than 3,900 miles is pollution from nonpoint sources.[55]

Erosion is a major cause of nonpoint pollution. Rainfall patterns, natural erodibility of the soil, physical features of slopes, and other

natural factors influence erosion, but what people do is usually more important in determining soil loss than all other factors combined.[56]

The following facts and examples illustrate the significance of nonpoint influences on water quality:

- Sediments from nonpoint sources are estimated to be 360 times the quantities discharged from municipal and industrial point sources after treatment, and agriculture contributes over 50 percent of all sediment loadings.
- Acre for acre, construction activities are the foremost contributor of sediment, averaging 1,100 tons per acre per year.
- Biochemical oxygen demand (BOD) and nutrient loadings from nonpoint sources (feedlots, landfills, agriculture) are approximately 5 to 6 times loadings from municipal and industrial point sources.
- By 1981, BOD levels from untreated urban runoff are projected to equal the BOD levels in treated effluent from municipal plants.
- Few data have been gathered nationally on toxic metals, but studies in urban areas have shown that concentrations of toxic metals in runoff are many times greater than concentrations in sewage.
- Outside urban areas, the runoff from past mining operations is the major contributor to toxic metal concentrations in streams.[57]

A 1977 report by the General Accounting Office on controlling nonpoint pollution sources made these statements:

> Nonpoint sources of water pollution—sediment, acid mine drainage, pesticides, and other pollutants carried into streams by runoff from rainstorms—currently produce more than half of the pollutants entering the nation's waterways.
>
> If not controlled, nonpoint pollution will prevent attainment of national water quality goals and will continue to grow in significance as point sources are brought under control.
>
> To date, progress in the control of nonpoint sources has been minimal.
>
> The best way to control nonpoint pollution is proper management of the land.
>
> EPA should do more to prevent nonpoint pollution by collecting data, eliciting help from other agencies, developing legislative proposals for more resources, and placing management of the program at a higher level.
>
> State and local agencies planning solutions to control nonpoint sources are not using adequate data for planning, and they cannot collect the necessary data because of program constraints due to emphasis on controlling point sources.[58]

The scope and extent of the influences on nonpoint pollution as summarized by the states are shown in Table 2–9. The influences of agriculture are the greatest, but 52 percent of the basins were polluted by urban runoff.

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Causes and Severity

Urban Areas Urban runoff, a primary cause of water quality degradation in populous areas, contains almost all types of pollutants. Suspended sediments and toxic materials, particularly heavy metals, cause the most harm, but bacteria, oxygen-demanding materials, nutrients, and oil and grease are also problems.

Pollutants in urban runoff come from air pollutants that settle in streets, erosion caused by construction, litter, chemical additives in fuels, and animal sources. These influences are understood only in principle, and their magnitude is not well-defined.

Quantities of material washed from the atmosphere that have been calculated for four cities are shown in Table 2–10. Sediment concentrations ranging from 115 to 314 milligrams per liter were produced in the urban runoff. For comparison, Figure 2–10 shows that mean sediment concentrations in streams in these same regions were considerably less.

Table 2-9

Nonpoint Source Pollution by Region 1977

	Percentage affected[1] by type of source								
Region	Number of basins	Urban runoff	Construction	Hydrologic modification	Silviculture	Mining	Agriculture	Solid waste disposal	Individual disposal
Northeast	40	70	15	20	10	20	55	35	63
Southeast	47	57	2	21	30	15	62	9	40
Great Lakes	41	54	7	2	15	41	59	15	39
North Central	35	54	6	3	6	40	89	9	29
South Central	30	52	0	23	13	53	87	13	40
Southwest	22	23	0	18	5	36	73	0	36
Northwest	22	23	23	23	27	23	55	9	32
Islands	9	67	67	22	0	0	78	22	99
Total	246	52	9	15	15	30	68	14	43

[1] In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Table 2-10

Estimated Materials Washed from the Atmosphere

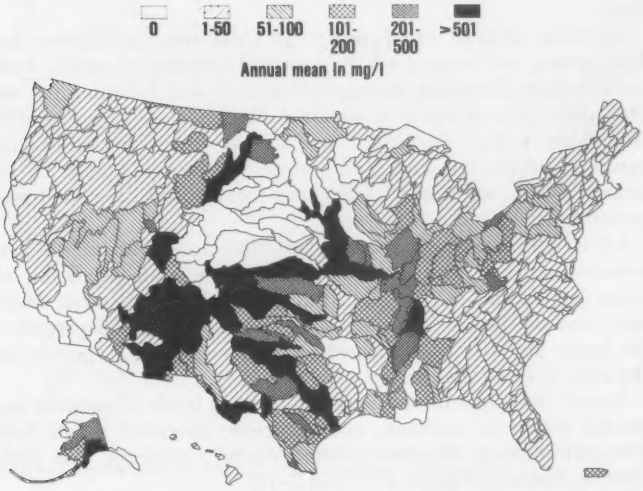
City	Dustfall (tons per square mile)		Annual precipitation (inches)	Impervious area runoff (inches)	Runoff-weighted concentration[1] (milligrams per liter)
	(per month)	(per year)			
New York	68.3	766	42	34	314
Cincinnati	22.3	268	40	32	115
Pittsburgh	51.1	613	36	29	292
Seattle	25.5	306	39	31	136

[1] Mean concentration of sediments in urban runoff that are caused by dustfall.

Source: H.P. Guy, "An Overview of Non-Point Water Pollution from the Urban-Suburban Arena," in P.M. Ashwood and R.C. Underwood, eds., *Non-Point Sources of Water Pollution* (Blacksburg, Va.: Virginia Water Resources Research Center, 1975), p. 51.

Figure 2-10

Mean Concentrations of Suspended Sediments at NASQAN Stations during the 1977 Water Year



Source: CEQ analysis of U.S. Geological Survey, National Stream Quality Accounting Network, data.

The large loadings of sediments from construction, primarily an urban activity, are illustrated by erosion data from Connecticut, shown in Table 2–11. Reports from the states summarized in Table 2–9 showed that the basins most affected by construction sediments are in the Pacific and Caribbean islands, the Northwest, and the Northeast.

The literature contains many examples of urban runoff with similarly high concentrations of biochemical oxygen-demanding materials, fecal coliform bacteria, toxic heavy metals, asbestos, chemical

Table 2-11

Estimated Soil Erosion Rates for Connecticut

Land use	Tons per acre per year
Natural woodland	0.11
Adequately managed cropland	2.73
Inadequately managed cropland	10.77
Urban area	0.86
Construction site	185.20

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1976 Report to Congress*, EPA–440/9–76–024 (Washington, D.C.: U.S. Government Printing Office, 1977), p. 5, based in part on Soil Conservation Service data.

nutrients, and organic materials. Downstream of Greenfield, Massachusetts, for example, the concentrations of chromium, copper, lead, nickel, and zinc in sediments are at least double the upstream concentrations, shown in Table 2–12. Biological indicators showed significant effects of pollution as the Green River passed through Greenfield.

Farming, Mining, and Forestry In rural areas, agriculture, surface mining, and forestry are the principal nonpoint sources of water pollution. By disturbing the vegetative cover and loosening the soil, they cause erosion and add stream sediments. Agriculture contributes nutrients and agricultural chemicals to waters, and mining can contribute acids, nutrients, and a variety of metals. Forests do not ordinarily degrade water quality, but logging and associated road construction often do.

Of all the sources of nonpoint pollution, agriculture is the most extensive, affecting over one-half of the basins in all geographic regions (see Table 2–9). In the North Central, South Central, Southwest, and the Pacific and Caribbean Islands regions, 83 percent of the basins are affected, compared with an average of 58 percent for the other parts of the country.

Runoff from agricultural land can increase levels of bacteria, suspended sediments, nutrients, and pesticides; irrigation return flows primarily increase dissolved solids (salinity), nutrients, and pesticides, as shown in Figures 2–11 and 2–12.

Nutrients are a particular problem in intensely farmed regions where concentrations of nitrogen and phosphorus in waters may be higher than anywhere else except in rivers subject to heavy loading from municipal wastes. The source of many of these nutrients is commercial fertilizer, but animal manure also makes an important nonpoint contribution. Figure 2–13 shows how agricultural and other land uses influence nutrient levels in streams.

Mining runoff and drainage adversely affect water quality in 30 percent of the nation's basins via runoff or drainage (see Table 2–9

Table 2-12

Sediment Concentrations of Heavy Metals from Urban Runoff, Greenfield, Massachusetts

(parts per million)

Metal	Concentrations	
	Upstream from urban area	Downstream from urban area
Chromium	60	125
Copper	25	64
Lead	9	75
Nickel	31	62
Zinc	56	133

Source: F.A. Digiano *et al.*, "Characterization of Urban Runoff—Greenfield, Mass., Phase II" (Amherst, Mass., Water Resources Research Center, 1976).

Figure 2-11

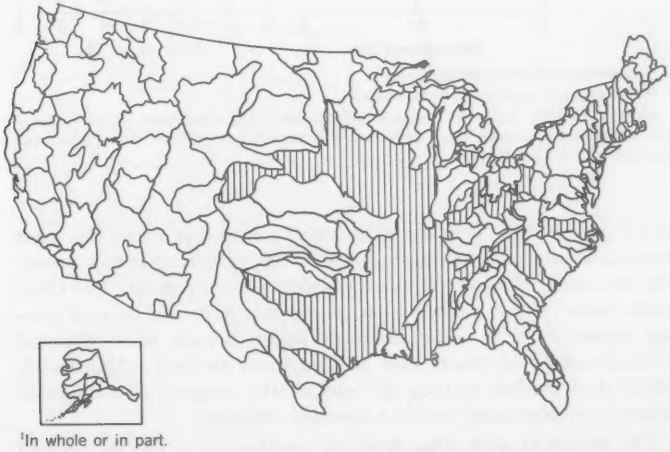
Basins Affected[1] by Excess Salinity from Nonpoint Sources 1977

[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-12

Basins Affected[1] by Pesticides from Nonpoint Sources 1977

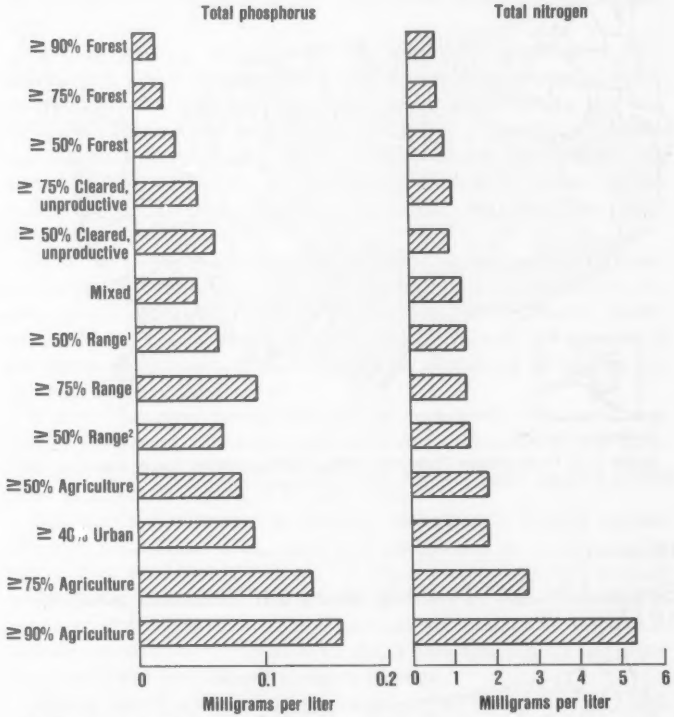


[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-13

Relationship of Land Use and Nutrient Concentrations in Streams



[1]Remaining land predominantly forest.
[2]Remaining land predominantly agriculture.

Source: James M. Omernik, *Nonpoint Source—Stream Nutrient Level Relationships: A Nationwide Study* (Corvallis: U.S. Environmental Protection Agency, Environmental Research Laboratory, 1977), pp. 28-29.

and Figure 2–14). It is the abandoned mines that cause the most severe and intractable problems because active mining is now generally regulated. Mining effects vary widely among regions. The Ohio River basin (Great Lakes region) is severely impacted by coal mining, especially acid mine drainage which occurs when exposed sulfur-bearing rock reacts with air and water to form sulfuric acid, which then leaches or runs off into nearby streams. Erosion from mining may also cause excess suspended sediment.

The extent of acid mine drainage problems was vividly pointed out in the Pennsylvania report to the Congress.[59] In approximately 2,000 of the 2,988 major stream miles which do not meet water

quality standards, drainage from abandoned mines is partly or wholly responsible. The volume of acid discharged into the rivers in coal mining areas is enormous; in the western third of Pennsylvania alone, 700 tons of acid per day enter major rivers (see Figure 2–15).

In the North Central, South Central, and Southwest regions, pollution by heavy metals from ore mining is a significant problem. Oil and gas extraction causes excess salinity in the South Central and North Central regions.

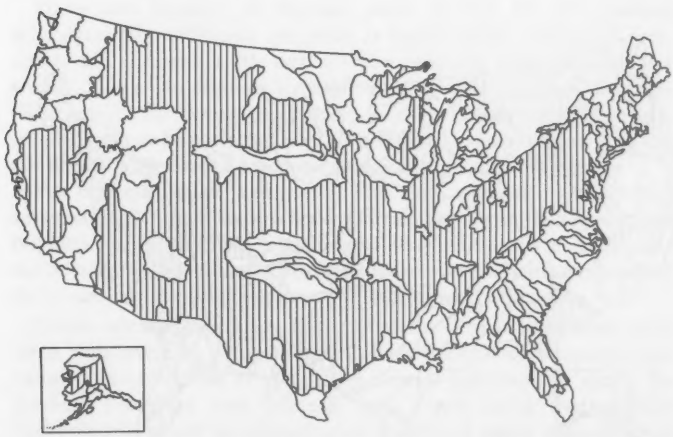
Forestry activities can cause severe erosion where logging roads are built and steep hillsides denuded. Runoff then causes high levels of suspended sediments in the streams and lakes that receive the runoff and excessive sediment deposits at the bases of slopes and in ditches and streambeds. Runoff can also carry along oxygen-demanding materials, nutrients, and pesticides. Widespread problems from silviculture activities are found primarily in the Southeast and Northwest (see Table 2–9 and Figure 2–16).

Other Sources Hydrologic modification of streams, such as by dredging, excavating, or dam installation, affects water quality in approximately 15 percent of the hydrologic drainage basins, as reported by the states (see Table 2–9). The basins affected are shown in Figure 2–17.

Dredging or excavation of streambeds to maintain navigation channels, reduce flooding potential, or facilitate irrigation can in-

Figure 2-14

Basins Affected[1] by Mining Activities 1977



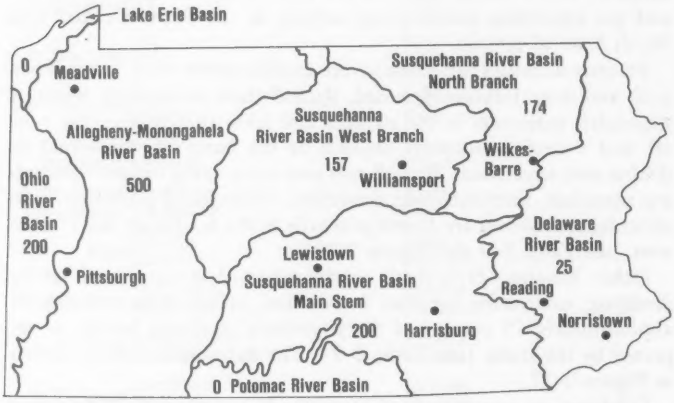
[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-15

Mine Acid Discharge per Day into the Major Rivers of Pennsylvania

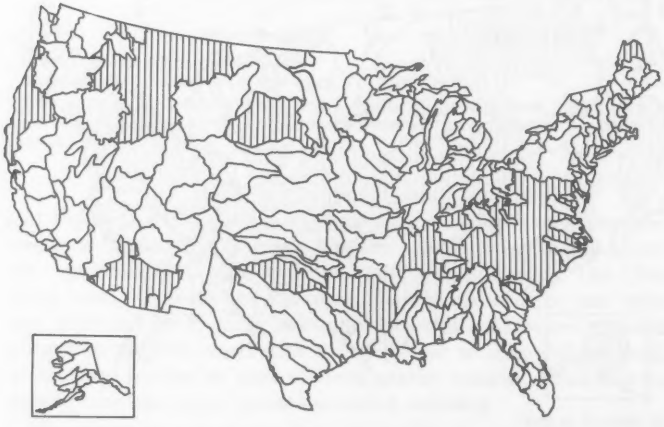
(tons)



Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1976 Report to Congress*, EPA-440/9-76-024 (Washington, D.C.: U.S. Government Printing Office, 1977), p. A-163.

Figure 2-16

Basins Affected[1] by Silvicultural Activities 1977

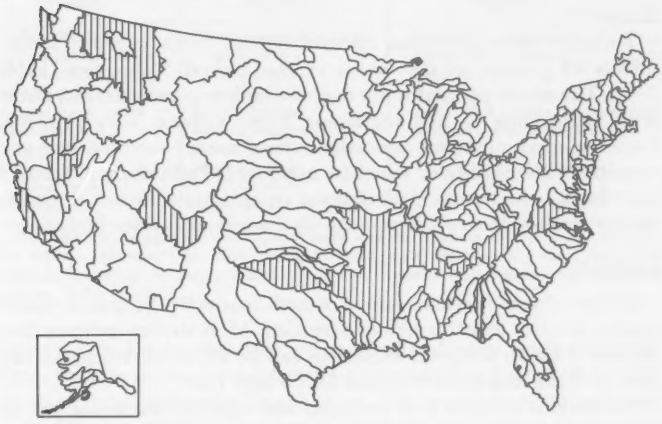


[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

Figure 2-17

Basins Affected[1] by Hydrological Modifications 1977



[1]In whole or in part.

Source: U.S. Environmental Protection Agency, *National Water Quality Inventory: 1977 Report to Congress* (Washington, D.C.: U.S. Government Printing Office, 1978).

crease the amount of suspended sediments and sediment deposits and destroy stream habitats. This problem, described in detail in the Arkansas and Tennessee state reports, affects many streams in the Lower Mississippi River basin.[60]

Dams may improve or degrade water quality. On the positive side, dam impoundments can serve as basins where suspended sediments and nutrients settle out, thereby reducing their levels downstream. Dams can regulate streamflow to provide adequate assimilative capacity for downstream waste loads (this flow regulation is a supplement, not an alternative, to adequate waste treatment). On the other hand, dams can cause serious water quality problems.

For example, water descending over dam spillways may become supersaturated with dissolved oxygen and nitrogen and cause gas bubble disease, which is fatal to fish. This problem is of particular concern in the Snake and Columbia Rivers in the Northwest, where dams also bar the migratory runs of salmon and other fish.

Water released from the deeper portions of many reservoirs contains high levels of nutrients and low levels of dissolved oxygen because of stratification of the water. Several southeastern states, including Tennessee and Georgia, with many dams that provide hydroelectric power mentioned poor quality of water released from reservoirs as a problem.

Solid waste disposal causes pollution because heavy metals, PCBs, and other substances from landfills or dumps can run off into nearby

surface waters or leach into ground waters. The problem is potentially critical; once polluted by a persistent toxic material, a ground water aquifer may take decades or even centuries to recover. This problem is of concern in the Northeast, but it may well be widespread. Unfortunately, the facts are few and understanding is limited.[61]

Pollution from individual disposal systems (such as septic tanks) affects 43 percent of the basins in the United States (see Table 2–9). The major pollutants are bacteria and, to a lesser extent, nutrients. Inadequate or malfunctioning septic systems were principal causes of contamination, especially in rural areas; overcrowding and unsuitable soil conditions were also important. Particularly in some of the islands, where individual disposal systems are common, contamination resulted from direct sewage discharges into water bodies.

Controls

Urban Areas Because urban runoff markedly influences water quality, control deserves serious attention. Most studies indicate that control of urban nonpoint influences can be achieved, but so far the controls have had limited success and a high cost.

An obvious solution is to impound and treat all the water just as sanitary wastes are treated. But the costs appear prohibitive because storage space would be required and the capacity of treatment plants may have to be doubled. Unfortunately, areawide planning under Section 208 of the Federal Water Pollution Control Act and steps for control of urban nonpoint pollution have taken a back seat to planning and controls for rural areas.

There are methods for hydraulic control measures that appear promising from the standpoint of cost—reducing sediment volume by running the water over lawns or other vegetated land, substituting vegetated drains for curb drainage, and storing water temporarily on parking lots, lawns, or other open spaces to reduce the peak runoff rate.

Rural Areas Controls of pollution from rural nonpoint sources are varied. Improved cropping methods, restricting mine drainage, and controlling erosion in logging illustrate the management practices used.

Cropping practices are probably the most important determinant of nonpoint pollution from agriculture. The amounts of sediment, nutrients, and pesticides that enter waterways depend largely on what crops are planted, how and when the soil is tilled, what fertilizers or animal wastes are applied, and when and what forms of pesticides or other means of control are used for weeds, insects, and diseases.[62] In agriculture, costs, crops, soil, and climatic conditions may impose additional limits of their own. Some effective control practices that are subject to such limitations are listed in Table 2–13.

The ways and timing of manure disposal can greatly influence the amounts of bacteria, nutrients, and oxygen-demanding materials in

Table 2-13

Pollution Control Practices Subject to Possible Crop, Soil, Climate, and Economic Limitations

Erosion	Nutrients	Pesticides
No-till planting	Eliminating excessive fertilization	Alternative pesticides
Conservation tillage	Timing nitrogen applications	Optimum placement
Sod-based rotations	Crop rotations	Crop rotations
Meadowless rotations	Animal wastes	Resistant varieties
Winter cover crops	Green legume crops	Controlled release formulations
Improved soil fertility	Incorporating applications	Mechanical or biological control
Timing field operations	Slow release fertilizer	Timing of applications
Plow-plant		

Source: J.E. Douglass, "Southern Forests and the Problem of Non-Point Sources of Water Pollution," in P.M. Ashwood and R.C. Underwood, eds., *Non-Point Sources of Water Pollution* (Blacksburg, Va.: Virginia Water Resources Research Center, 1975), p. 33.

runoff. It is known that nitrogen and phosphorous levels in runoff from manure applied in winter are approximately four times as high as those from springtime application. The numbers of animals per acre can also influence loading of nutrients and oxygen-demanding materials.[63]

Areawide Planning Comprehensive areawide planning and management under Section 208 of the 1972 Act is a primary vehicle for controlling nonpoint source pollution, rural and urban. As discussed in the section on agriculture in Chapter 6, the same management planning that conserves fertile soil for farming protects rural streams from water quality damage. As noted there, EPA has an agreement with the Department of Agriculture to develop jointly the "best management practices" for controlling runoff pollution from farms.[64] Provisions of the 1977 Clean Water Act authorizing this program are discussed below.

South Dakota, Iowa, Illinois, New Jersey, New York, Pennsylvania, and Hawaii regulate sediment and erosion from agricultural activities. Montana and North Dakota are among the states that regulate all animal confinement facilities, and South Dakota has developed a grant program to assist farmers in building diversions and retention facilities to prevent runoff from feedlots. Five states have Forest Practices Acts regulating silviculture activities.[65] EPA has compiled 58 cases of effective action by local 208 agencies in controlling nonpoint sources and solving other water quality management problems; actions range from revising local zoning ordinances and subdivision regulations to protect ground water to adopting a statewide antidegradation policy.[66]

Responsibilities of Federal Agencies Federal agencies are also lending technical assistance to states and localities in developing

parts of their areawide Section 208 programs. The Soil Conservation Service, the Agricultural Extension Service, and the Forest Service have assigned people to approximately 50 state and local agencies to help develop agriculture and silviculture nonpoint source control programs. The Bureau of Reclamation in the Department of the Interior has an Irrigation Management Service Program to help farmers increase irrigation efficiency and reduce salinity in irrigation return flows. The Geological Survey, also in Interior, has cooperative programs with 208 agencies to collect water data, assess river quality, and investigate ground water.

The slow progress of the Section 208 program continues to frustrate water quality managers and many citizens. The program has been difficult to implement because of funding impoundments, lack of data on nonpoint source pollution, and the slow development of economical control techniques. The dominant problem appears to be an institutional one, however. Solutions to complex local and regional water quality management problems will ultimately be devised locally and regionally. Yet the incentives for local governments to develop and implement effective water quality management programs are limited and often are overshadowed by the availability of federal construction grants and statutory compliance deadlines for point sources. The Congress did not include in the 1977 Clean Water Act an Administration proposal that continued construction grant funding be conditioned on development and implementation of effective 208 plans.

Changes in the Law

The 1977 Amendments strengthen Section 208 programs for comprehensive areawide control of rural nonpoint sources and weaken it for urban sources.[67] The Amendments authorize a new program for the Department of Agriculture, in conjunction with EPA, to provide technical and financial assistance to farmers for implementing areawide management plans under Section 208. USDA, with the concurrence of EPA, may contract with farmers to install measures to reduce agricultural runoff. Only those soil conservation measures approved in a state 208 plan as "best management practices" will be eligible for funding.

The Amendments also authorize states to assume regulatory responsibility under Section 208 for regulating the discharge of dredged or fill materials in connection with some farming, lumbering, mining, and construction activities that are now regulated by the Corps of Engineers under Section 404 of the FWPCA.[68]

On the negative side, the Congress repealed the eligibility of storm water pollution controls for construction grants funding until 1983. This action will retard the development and implementation of nonpoint source controls in cities.

TOXIC SUBSTANCES

Contamination of water by heavy metals, pesticides, PCBs, and other organic chemicals has attracted national attention only in recent years. These toxic pollutants can harm aquatic or human life in extremely low concentrations, which are often difficult to detect. Long-term, low-dosage (chronic) effects, including carcinogenic, mutagenic, and teratogenic effects, often present an even greater danger to the general health of the aquatic environment than do their acutely toxic effects.

Toxic pollutants enter the aquatic environment from a variety of point and nonpoint sources—some of the most common are industrial discharges, urban stormwater runoff, atmospheric fallout, agricultural runoff of pesticides, leachates from sanitary landfills, mine drainage, and accidental spills of chemicals.

The 129 Priority Toxic Pollutants

Controlling the levels of toxic substances in the environment is difficult because potentially toxic pollutants are extremely numerous and hard to detect, their sources are diverse, and information about their effects is fragmentary.

A 1975 suit against EPA by the Natural Resources Defense Council[69] led to a settlement agreement which specified 65 classes of toxic pollutants. EPA expanded the 65 classes to a list of 129 specific pollutants primarily using technology-based standards for industrial discharges but also employing more specific controls where needed. The 129 substances may be divided into 10 categories, as shown in Table 2–14.

A recent EPA study of surface waters, generally near industrial areas, showed that human activity has introduced toxic pollutants at significant levels in the waters.[70] Concentrations of inorganic pollutants, such as heavy metals, were well above what would be expected from natural background sources. Many synthetic organic pollutants were also found in the study. The investigators collected 204 water samples and analyzed a number of pollutants, including the 129 priority toxic pollutants. The kinds of organic analyses used on these samples were not designed to detect PCBs or the chlorinated hydrocarbon pesticides.

Sample sites were not selected because they are representative of the nation's water quality; rather, they are areas where water quality problems from toxic pollutants might reasonably be expected. Of the 204 sites, 181 were surface water quality stations, and the remainder were at drinking water treatment plants and at sewage treatment plants. The analyses did not include sediments.

Samples were collected from 12 of the 15 major drainage basins in the 48 contiguous states (Figure 2–18). With the focus on industrial areas, the Missouri River basin, the Colorado River basin, and the Great Basin (Nevada, western Utah and southeastern California) were not sampled. Because the number of samples taken varied

Table 2-14

The 129 Priority Toxic Pollutants

Pollutant	Characteristics	Sources	Remarks
Pesticides Generally chlorinated hydrocarbons	Readily assimilated by aquatic animals, fat soluble, concentrated through the food chain (biomagnified), persistent in soil and sediments	Direct application to farm- and forestlands, runoff from lawns and gardens, urban runoff, discharge in industrial wastewater	Several chlorinated hydrocarbon pesticides already restricted by EPA; aldrin, dieldrin, DDT, DDD, endrin, heptachlor, lindane, and chlordane
Polychlorinated biphenyls (PCBs) Used in electrical capacitors and transformers, paints, plastics, insecticides, other industrial products	Readily assimiliated by aquatic animals, fat soluble, subject to biomagnification, persistent, chemically similar to the chlorinated hydrocarbons	Municipal and industrial waste discharges disposed of in dumps and landfills	TSCA ban on production after 6/1/79 but will persist in sediments; restrictions on many freshwater fisheries as a result of PCB pollution (e.g., lower Hudson, upper Housatonic, parts of Lake Michigan)
Metals Antimony, arsenic, beryllium, cadmium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc *Other inorganics* Asbestos and cyanide	Not biodegradable, persistent in sediments, toxic in solution, subject to biomagnification *Asbestos* May cause cancer when inhaled, aquatic toxicity not well understood *Cyanide* Variably persistent, inhibits oxygen metabolism	Industrial discharges, mining activity, urban runoff, erosion of metal-rich soil, certain agricultural uses (e.g., mercury as a fungicide) *Asbestos* Manufacture and use as a retardant, roofing material, brake lining, etc.; runoff from mining *Cyanide* Wide variety of industrial uses	
Halogenated aliphatics Used in fire extinguishers, refrigerants, propellants, pesticides, solvents for oils, and greases and in dry cleaning	Largest single class of "priority toxics," can cause damage to central nervous system and liver, not very persistent	Produced by chlorination of water, vaporization during use	Large volume industrial chemicals, widely dispersed, but less threat to the environment than persistent chemicals

Ethers Used mainly as solvents for polymer plastics	Potent carcinogen, aquatic toxicity and fate not well understood	Escape during production and use	Though some are volatile, ethers have been identified in some natural waters.
Phthalate esters Used chiefly in production of polyvinyl chloride and thermoplastics as plasticizers	Common aquatic pollutant, moderately toxic but teratogenic and mutagenic properties in low concentrations; aquatic invertebrates are particularly sensitive to toxic effects; persistent; and can be biomagnified	Waste disposal vaporization during use (in nonplastics)	
Monocyclic aromatics (excluding phenols, cresols and phthalates) Used in the manufacture of other chemicals, explosives, dyes and pigments, and in solvents, fungicides, and herbicides	Central nervous system depressant; can damage liver and kidneys	Enter environment during production and byproduct production states by direct volatization, wastewater	
Phenols Large volume industrial compounds used chiefly as chemical intermediates in the production of synthetic polymers, dyestuffs, pigments, pesticides, and herbicides	Toxicity increases with degree of chlorination of the phenolic molecule; very low concentrations can taint fish flesh and impart objectionable odor and taste to drinking water; difficult to remove from water by conventional treatment; carcinogenic in mice	Occur naturally in fossil fuels, waste water from coking ovens, oil refineries, tar distillation plants, herbicide manufacturing, and plastic manufacturing; can all contain phenolic compounds	
Polycyclic aromatic hydrocarbons Used as dyestuffs, chemical intermediates, pesticides, herbicides, motor fuels, and oils	Carcinogenic in animals and indirectly linked to cancer in humans; most work done on air pollution; more is needed on the aquatic toxicity of these compounds; not persistent and are biodegradable though bioaccumulation can occur	Fossil fuels (use, spills, and production), incomplete combustion of hydrocarbons	
Nitrosamines Used in the production of organic chemicals and rubber; patents exist on processes using these compounds.	Tests on laboratory animals have shown the nitrosamines to be some of the most potent carcinogens.	Production and use can occur spontaneously in food cooking operations	

Figure 2-18

Basins Sampled for Toxic Substances in EPA Survey

Region		Number of sites sampled	Region		Number of sites sampled
1	Northeast	33	9	Missouri River	0
2	North Atlantic	27	10	Southwest - Lower Mississippi	11
3	Southeast	7	11	Colorado River	0
4	Tennessee River	7	12	Western Gulf	8
5	Ohio River	20	13	Pacific Northwest	5
6	Lake Erie	7	14	California	9
7	Upper Mississippi	38	15	Great Basin	0
8	Western Great Lakes	9			

from basin to basin, it is not possible to make direct comparisons, but it is possible to make some general observations.

All the inorganic toxic substances were found in the 12 major drainage basins sampled. Although these elements occur naturally, many are at higher levels because of human activity. In two-thirds (eight) of the basins sampled, six or more inorganic toxics exceeded proposed ambient water quality criteria in at least one sample. Cadmium, chromium, mercury, and selenium were in violation of proposed criteria in at least 10 percent of the samples taken (see Table 2–15 and Figure 2–19).

Mercury is a serious problem in all 12 major drainage basins sampled; concentrations exceeded ambient water quality criteria at more than three-fourths of the stations. The median values range from 0.4 to 2.1 micrograms per liter, which is significantly above the EPA aquatic life protection criterion of 0.05 micrograms per liter. The North Atlantic and Western Gulf basins had particularly high median values for mercury, 2.1 micrograms per liter.

Chromium is another inorganic pollutant found in concentrations

Table 2-15

Inorganic Toxic Pollutants by Basin[1]

(micrograms per liter)

Major basin	Number of sites	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Zinc
1	33	D D–600	11 D–60	D D–41	D D–69	1.1 D–27	4 D–104	D D–196	30 11–656
2	27	D D–23	D D–66	D D–29	23 D–92	2.1 D–31	D D–18	D D–18	50 11–213
3	7	D D–415	8.2 D–20	D D–20	D D–20	1 0.7–4	5 D–20	0.6 D–1.3	24 D–57
4	7	D D–55	9 2–32	20 D–100	30 D–90	1.5 0.3–16	9 D–16	1 D–5.3	25 D–225
5	20	D D–55	5.6 D–95	D D–95	D D–90	.8 0.2–2	0.9 D–30	0.6 D–1.8	26 D–120
6	7	D D–9	26 16–80	D D–30	D D–50	0.8 D–50	20 D–65	0.5 D–7.4	35 13–355
7	38	D D–80	14 D–62	D D–60	D D–80	1.3 D–4.5	D D–125	0.6 D–7	28 D–245
8	9	D D–20	40 4.8–63	D D–60	D D–55	0.4 D–1.1	10 D–27	0.5 D–7.7	35 D–80
10	11	D D–30	49 D–80	D D–30	D D–30	0.9 D–12	D D–14	1.5 D–5.8	49 D–105
12	8	D D–750	35 3–62	D D–25	27 D–40	2.1 0.7–60	14 D–23	1.5 D–30	47 D–163
13	5	D D–7	7.2 D–20	D D–70	D D–30	D 0.3–40	D D–9	D D–4	11 D–21
14	9	D D–610	38 5–95	33 D–75	D D–63	1.9 D–50	D D–30	D D–15	11 D–130

D = Detected but not quantifiable

[1] Concentrations shown are for whole water samples (water plus suspended sediment).

The upper figure for each pollutant is the median, the lower figure the range.

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

exceeding the proposed water quality criteria for aquatic life (30 micrograms per liter) in almost all the basins sampled. Especially high concentrations were found in the Western Great Lakes, Southwest-Lower Mississippi, Western Gulf, and California drainage basins. There the median values exceeded proposed criteria.

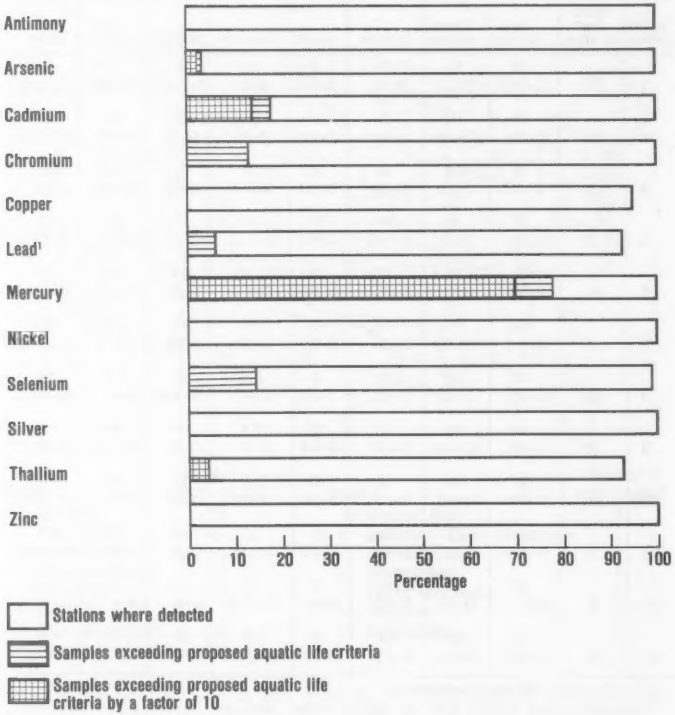
Cadmium concentrations exceeded the proposed criterion of 0.2 micrograms per liter at 18 percent of the stations sampled. Samples exceeding the criterion were particularly prevalent at stations in the Southeast, Western Gulf, and California basins.

Selenium was found in excess of its 4 micrograms per liter proposed aquatic life protection criterion at 14 percent of the stations. The average median value was 0.6 micrograms per liter. Levels were

270-922 O - 79 - 12

Figure 2-19

Inorganic Toxic Pollutants Detected in EPA Survey



[1]Samples exceeding drinking water criteria.
Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

particularly high in the Northeast, North Atlantic, Southeast, Southwest, and Western Gulf drainage basins.

Six of the EPA priority organic toxic pollutants—chloroform; 1,1,1, trichloroethane; trichloroethene; tetrachloroethene; di-n-butyl phthalate; and bis (2-ethylhexyl) phthalate—were found at more than one-fourth of the stations sampled. Concentrations detected are given in Table 2–16. Chloroform and both phthalates were widespread; each was found at more than 75 percent of the locations sampled. Three of them (di-n-butyl phthalate, bis (2-ethylhexyl) phthalate, and 1,1,1 trichloroethane) were found in excess of proposed water quality criteria at more than 10 percent of the stations, as shown in Figure 2–20. No criterion has been proposed for chloroform.

The phthalate esters are a widespread pollution problem. In addition, an extremely low criterion of 0.3 micrograms per liter for

Table 2-16

Organic Toxic Pollutants by Basin[1]

(micrograms per liter)

Major basin	Number of sites	Chloroform	1,1,1 trichloroethane	Trichloroethene	Tetrachloroethene	Di-n-butyl phthalate	Bis (2-ethylhexyl) phthalate
1	33	4 0–20	0 0–3	1 0–10	1 0–9	1 0–20	1 0–2,347
2	27	2 0–13	0 0–1	1 0–24	1 0–5	0 0–2	0 0–49
3	7	1 0–3	0 0–0	0 0–1	0 0–0	0 0–1	0 0–3
4	7	3 0–11	0 0–4	0 0–3	0 0–13	0 0–8	1 0–31
5	20	1 0–7	0 0–0	0 0–1	0 0–0	0 0–5	1 0–4
6	7	0 0–9	0 0–0	0 0–188	0 0–45	0 0–2	1 0–6
7	38	9 0–120	0 0–2	1 0–13	0 0–11	0 0–4	0 0–7
8	9	1 0–8	0 0–1	0 0–0	0 0–0	0 0–1	1 0–2
10	11	2 0–87	0 0–0	0 0–1	0 0–7	0 0–2	0 0–2
12	8	1 0–5	0 0–0	0.5 0–3	1 0–22	0 0–1	2 0–3
13	5	0 0–4	0 0–0	0 0–0	0 0–0	0 0–0	0 0–1
14	9	0 0–3	0 0–0	0 0–0	0 0–1	0 0–60	0 0–0

[1] Concentrations shown are for whole water samples (water plus suspended sediment).

The upper figure for each pollutant is the median, the lower figure the range.

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

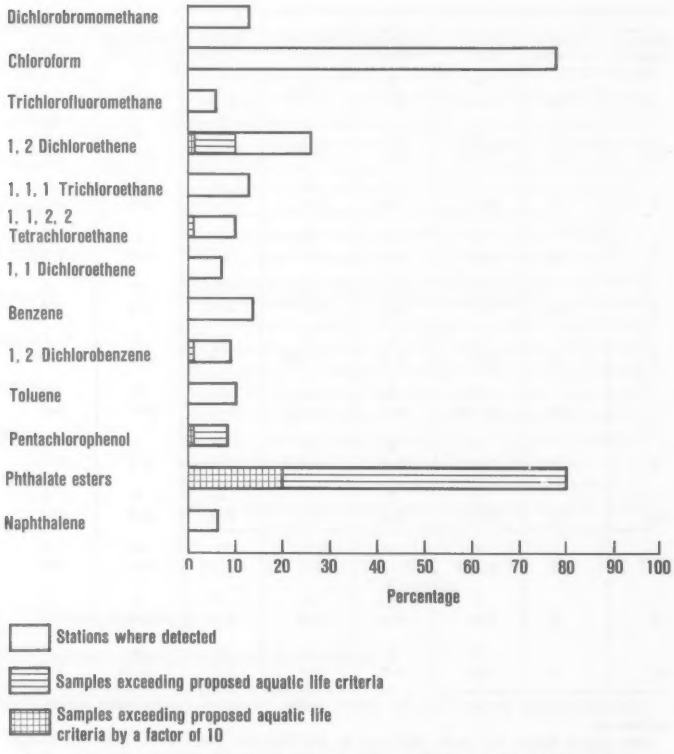
aquatic life protection has been proposed for the total amount of phthalate esters in a water sample. Samples at 78 percent of the stations sampled were in excess of this criterion.

An important intermediate product from which other organic chemicals are synthesized—1,2 dichloroethane—was found in 9 of the 12 major drainage basins sampled; 1,2 dichloroethane is a particularly serious pollutant in the Northeast and North Atlantic drainage areas, where 93 samples were in excess of the proposed water quality criterion.

The problem of trichloroethene, although widespread, is significant only in the Northeast, Lake Erie, and Upper Mississippi drainage basins, where 14–19 percent of the samples were in excess of the

Figure 2-20

Organic Toxic Pollutants Detected in EPA Survey



Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

4.6 micrograms per liter aquatic life protection criterion. These basins accounted for all but one of the excesses above the criterion.

The results tend to underestimate the magnitude of the problems from toxic pollutants. Although each toxic material in a given water body may not be present in excess of its water quality criterion, the additive effects of many toxic substances in low concentrations can put significant stress on an aquatic ecosystem. Each pollutant increases the range of factors to which biota must respond, even when the individual quantities are small. Sometimes pollutants have synergistic effects, increasing their toxicities. On the other hand, some pollutants may have antagonistic effects which could reduce the overall toxicity from the added effects.

In addition to the ambient surface water samples, 26 samples were taken at 13 water treatment plants, one-half prior to treatment and one-half after treatment. In most municipalities treatment consists of filtering chlorination. Chlorination effectively disinfects, but it can also alter organic compounds by adding chlorine to the chemical structure. This may create toxic chlorinated organic compounds from relatively harmless substances or increase the toxicity of already harmful materials.

The EPA study showed that concentrations of three compounds, chloroform, dichlorobromomethane, and chlorodibromomethane, increased markedly during treatment. In 10 of the 13 plants, chloroform levels were higher in finished drinking water. Chloroform values in the finished drinking water samples ranged from 22 to 68 micrograms per liter. The average increase for the 13 plants was 27 micrograms per liter, and in 3 plants chloroform was found only after treatment. Dichlorobromomethane was detected in 11 of the 13 drinking water samples and in only 1 of the untreated samples. Posttreatment levels ranged from 2 to 14 micrograms per liter, with an average increase of 5.9. Chlorodibromomethane was detected in 10 untreated samples; the range of values in the drinking water samples was 1–10 micrograms per liter, with an average increase of 3.9. The EPA standard for drinking water is 100 micrograms per liter for total halogenated methanes.

The National Organics Monitoring Survey

In 1976 EPA began the National Organics Monitoring Survey to determine the frequency of occurrence of specific contaminants in 113 drinking water supplies representing various sources and treatment processes. Data were to be used in establishing requirements for the control of organic compounds in drinking water.

The study demonstrated the presence of trihalomethanes (chloroform, bromoform, chlorodibromomethane, and dichlorobromomethane) in the water after treatment, as shown in Table 2–17. By far the most widespread synthetic organic contaminants in drinking water, they also occur at the highest concentrations (up to 784 micrograms per liter). They are produced by chlorination during treatment of naturally occurring precursors, which are probably in humus but may also be in algae and other chemicals.

Besides trihalomethanes, most compounds studied in the survey and generally present in drinking water are there because the raw water is contaminated. An exception is 2,4 dichlorophenol, which is generally produced by chlorination of phenol or related precursors.

Many other synthetic products were also detected; generally their concentrations were very low and the number of occurrences small. The common volatile halogenated solvents and chemical intermediates (i.e., chlorinated ethanes, ethylenes, and benzenes) were typical. Carbon tetrachloride probably resulted from contamination of the chlorine or was present in the raw water supply.

Table 2-17

Trihalomethanes in 113 Drinking Water Supplies

(micrograms per liter)

Trihalomethane	Phase I [1]	Phase II [2]	Phase III	
			Dechlorinated [3]	Terminal [4]
Chloroform				
Median	27	59	22	44
Mean	43	83	35	69
Range	ND–271	ND–47	ND–20	ND–540
Bromoform				
Median	D	D	D	D
Mean	3	4	2	4
Range	ND–39	ND–280	ND–137	ND–190
Chlorodibromomethane				
Median	D	4	2	3
Mean	8	12	6	11
Range	ND–190	ND–290	ND–114	ND–250
Dichlorobromomethane				
Median	10	14	6	11
Mean	18	18	9	17
Range	ND–183	ND–180	ND–72	ND–125
Total				
Median	45	87	37	74
Mean	68	117	53	100
Range	ND–457	ND–784	ND–295	ND–695

ND = Not detected

D = Detected but not quantifiable

[1] The water samples were stored at 2–8° C for 1–2 weeks before analysis.

[2] The water samples were stored at 20–25° C for 3–6 weeks before analysis.

[3] During analysis sodium thiosulfate was added to neutralize the chlorine, thereby quenching the reaction.

[4] During analysis the reaction proceeded to completion.

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

GROUND WATER

Most users of ground water assume that is is safe and unpolluted, counting on the earth's natural ability to filter water. For the most part they are correct, but ground water occasionally becomes polluted—from wastes discharged to the ground, as through injection wells or septic systems; unintentional leaks from sewers or fuel tanks, for example, or leaching from sanitary landfills or from chemicals applied to soils; intrusion of seawater, saline ground water, or polluted river water caused by overpumping.

Water quality problems in ground water are compounded by the slow movement of the water. It may be polluted long before the pollution is detected at a well, and flushing the contaminated water from the acquifer may be impossible. Sometimes the only options are to declare the water unfit and seek alternate supplies or treat every gallon before use.

Ground water is often pumped from private wells for one family or for one farm. Usually the water is neither treated nor monitored. State programs to ensure the safety of ground water are few. The Safe Drinking Water Act of 1974 provides for regulation of water systems which commonly use ground water—systems with as few as 15 service connections or 25 individuals served.[71] Campgrounds, trailer parks, and small housing developments using common wells, then, are regulated, but not individual residences or farms. The Act sets requirements for states for controlling materials injected underground and for strictly protecting "sole source aquifers" that are used for drinking water supplies.[72]

Assessing the overall quality of ground water is much more difficult than evaluating surface water, and monitoring ground water receives only a fraction of the funds used for monitoring streams, lakes, and coastal waters. The data that are required by the Safe Drinking Water Act are not assembled in any accessible data base. Further, there is no compilation of state regulations on ground water. Certainly ground water has no equivalent to NASQAN, and state reports on water quality give scant attention to ground water. A Federal Interagency Task Force on Environmental Data and Monitoring headed by CEQ is working on plans to improve the information base for evaluating ground water.

Figure 2–21, a summary of national ground water quality, shows aggregate subregions reporting problems of ground water quality and indicates sources of the problems.

The importance of ground water management to water quality is exemplified by Long Island, where nearly 3 million residents rely on ground water for their entire fresh water supply. Surface water supplies are limited and are derived almost wholly from ground waters. For this reason, protection of quantity and quality is critical to the area.

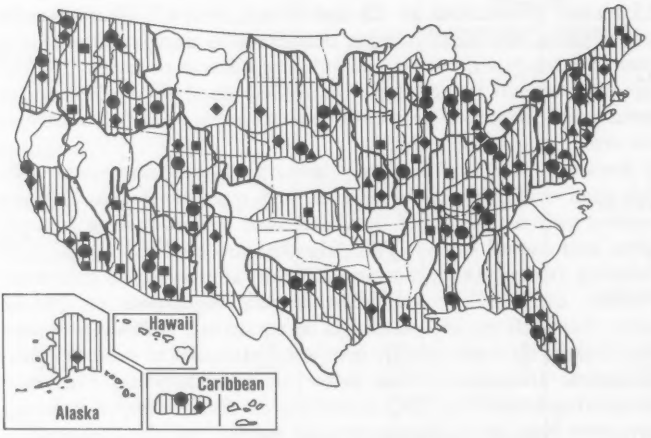
The Nassau-Suffolk Regional Planning Board, whose jurisdiction is all of Long Island east of Brooklyn and Queens, was one of the first agencies designated by EPA to develop a regional water quality management plan under Section 208 of the Federal Water Pollution Control Act.

Long Island traditionally relied on cesspools, septic tanks, and leaching fields for disposal of domestic wastes. But as populations increased, particularly in Nassau County, more areas have become sewered to prevent contamination of ground water. Sewage wastes are generally discharged to the ocean, resulting in less domestic waste waters available for recharging the aquifers. This situation plus the extended drought occasionally caused significant drops in Long Island's ground water table and lead to incidents of saltwater intrusion into the aquifers.

Comprehensive water supply studies show that the Long Island aquifers can yield some 600 million gallons per day, compared to current consumption of about 240 million gallons per day.[73] Al-

Figure 2-21

Ground Water Contamination 1977



Areas with greatest total impact: areas that have ground water contamination

Location of specific impacts

- Contamination resulting from toxic industrial wastes
- Contamination resulting from leaching of municipal and industrial wastes, from waste runoff through oil and gas fields, and from other excavations
- Contamination resulting from leaching of wastes from land fills
- Salt and other chemical contamination of aquifers from irrigation and other agricultural activities
- Inadvertent contamination from well drilling, harbor dredging, and excavation for drainage systems

Source: U.S. Water Resources Council, "Preliminary Water Resources Problem Statements" (St. Louis, Mo.: Harbridge House, Inc., 1977), National Conference on Water, May 23-25, 1977, program materials, p. 13.

though the maximum yield would further drop the water table and could move the saltwater interface inland about 1 mile before equilibrium was reached, Long Island could readily meet its water needs if regional planning could ensure that supplies would be transported to the more populous areas.

The problems that affect the quality of Long Island ground water may be more difficult to solve. A Long Island report listed 19 possible causes of pollution, as shown in Table 2–18. Of greatest concern has been the large number of domestic onsite waste disposal systems. They can cause contamination from bacteria and viruses, detergents, metals, nutrients such as nitrates, and toxic compounds found in cleaners, solvents, and other household products. Also identified as significant potential contributors of toxic and other pollutants were industrial discharges, storm water recharge basins, landfill leachates,

Table 2-18

Sources and Causes of Ground Water Contamination

Systems, facilities, or sources designed to discharge waste or waste waters to the land and ground waters	Systems, facilities, or sources not specifically designed to discharge wastes or waste waters to the land and ground waters	Systems, facilities, or sources which may discharge or cause a discharge of contaminants that are not wastes to the land and ground waters	Causes of ground water contamination which are not discharges
Domestic onsite waste disposal systems	Sanitary sewers	Highway deicing and salt storage	Airborne pollution
Sewage treatment plant effluent	Landfills	Fertilizers and pesticides	Water well construction and abandonment
Industrial waste discharges	Animal wastes	Product storage tanks and pipelines	Saltwater intrusion
Storm water basin recharge	Cemeteries	Spills and incidental discharges	
Incinerator quench water		Sand and gravel mining	
Diffusion wells			
Scavenger waste disposal			

Source: Geraghty & Miller, Inc., *Ground Water Conditions*, Interim Series 4, prepared for the Nassau-Suffolk Regional Planning Board (Hauppauge, N.Y., 1977), p. 19.

oil and chemical storage tanks, and animals (cattle, horses, dogs, chickens, turkeys, ducks).[74]

Data on ground water quality indicate that significant impacts have occurred in many areas of Long Island.[75] Elevated levels of nitrates, primarily from domestic waste disposal systems and fertilizers, were widespread, occasionally exceeding the EPA drinking water criteria of 10 milligrams per liter. This level is approximately 100 times the measured background concentration of 0.11 milligrams per liter. Heavy metals were found at many sites, generally in low concentrations. Recent sampling led to restrictions on 19 public supply wells because of the high levels of toxic organic contaminants found.

In order to prevent further pollution of ground water on Long Island and to allow recovery of contaminated aquifers, control of many sources and causes will be necessary. Changes in regulations for waste disposal and a detailed areawide plan will have to be made.

THE DROUGHT OF 1976–77

The 1976–77 drought affected much of the central and western United States; crops were lost, fish died, saltwater intruded into rivers and aquifers, water quality was degraded, and people accustomed to plenty of water at the turn of a tap faced rationing—sometimes severe rationing. For example, California rainfalls averaged only 47 percent of normal at 19 representative stations, streamflow was the lowest on record at many stations, and storage in reservoirs was only 39 percent of normal.[76]

Water quality was noticeably affected as the drought upset the balance between water availability and use. As the water ran short, human demands for irrigation, domestic and industrial supply, and waste disposal continued. The first to suffer were fish and wildlife as streams dried up and spawning areas were lost. Later even the human wants and needs were unsatisfied. Water quality degraded as saltwater intrusion and undiluted waste took their toll. Some important effects of the drought reported in California follow:

- In 1976 saltwater intruded into the Sacramento-San Joaquin estuary 7 miles farther upstream than is normal (shown in Figure 2–22), and in 1977 it extended an additional 4 miles, shutting off many freshwater users and affecting fish and other aquatic life. Earthfill barriers were constructed across several channels to limit the intrusion.
- Klamath hauled freshwater because saltwater intruded into the aquifer tapped by municipal supply wells.[77]
- Recreation was also affected. Many reservoir levels fell below the boat ramps, making access impossible. The higher than normal use of the facilities on the American River reach near Sacramento, for example, combined with reduced dilutive capacity to increase bacteria counts and cause some areas to be closed to water contact recreation.
- Survival rates for species such as salmon, striped bass, and shad were much lower than normal. Factors responsible were the reduction or elimination of fish spawning and nesting habitats due to low flow, increased temperatures in streams and reservoirs, and low dilution of toxic pollutants.
- The extensive effects of the drought on agriculture were related primarily to water shortages. The drought also caused salinity intrusion in the central California area, which caused some additional agricultural losses and impacted paper pulp production in the area.[78]

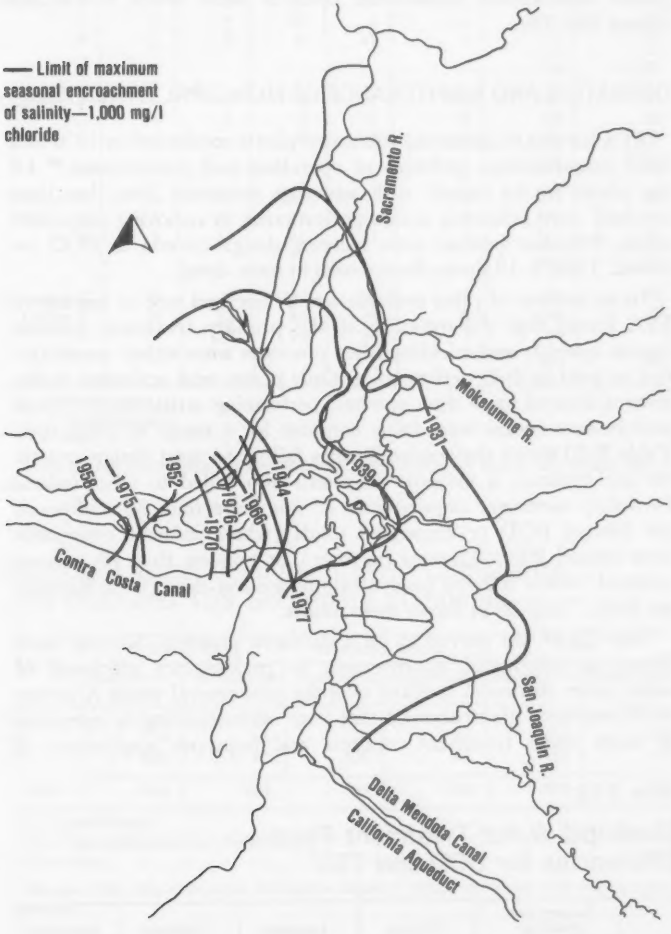
ISSUES TO WATCH

COMMUNITIES' ABILITY TO PAY FOR TREATMENT PLANTS

More than one-half of EPA's current grants for municipal treatment facilities (over 46,000) are for planning of treatment facilities, and new planning grants are being made at a rate of more than 2,000 per year, most going to smaller towns. Concern is growing that if the treatment plants which are eventually built use conventional approaches, municipalities may not be able to afford the operating costs. An EPA survey of 258 facility plans for communities with populations under 50,000 revealed that the total costs of the planned systems would exceed $100 per year for homeowners in 40 percent of the towns and over $200 per year for homeowners in 10 percent of the towns. For residents of communities with fewer than 10,000

Figure 2-22

Saltwater Intrusion into the Sacramento-San Joaquin Estuary during the 1976-77 Drought



Source: Adapted by the U.S. Geological Survey from Department of Interior, Bureau of Reclamation, *Special Task Force Report on San Luis Unit: Central Valley Project, California* (Washington, D.C.: U.S. Government Printing Office, 1978), p. 111.

people, projected annual costs approach $300 and sometimes more per household.[79] The problem is made more acute by the fact that many small town homeowners have incomes well below the national median. The changes in the 1977 Amendments and in EPA policy discussed earlier encourage facility planners to consider more cost-effective alternatives. EPA Administrator Douglas Costle has suggested that annual homeowner costs in small towns should not exceed $66–130.

OPERATION AND MAINTENANCE OF MUNICIPAL FACILITIES

EPA surveys of operating treatment plants conducted in 1976 and 1977 reveal serious problems of operation and maintenance.[80] Of the plants in the sample with adequate operating data, less than one-half were achieving design performance in removing suspended solids. Fifty-five percent were meeting design criteria in BOD removal. Table 2–19 shows these results in more detail.

In an analysis of plant performance by size and type of treatment, EPA found that the majority of the primary treatment systems, lagoon systems, and trickling filter processes were either unsatisfactory or poor in their performance. Only plants with activated sludge systems showed more than one-half performing satisfactorily. These performance results were fairly constant for a range of plant sizes. Table 2–20 shows the results. Besides failing to meet design criteria for performance, a majority of plants also failed to meet federal secondary treatment requirements of not more than 30 milligrams per liter of BOD or suspended solids (where influent concentrations exceed 200 milligrams per liter) or not less than 85 percent removal (where influent concentrations are less than 200 milligrams per liter). Table 2–21 shows these results.

Poor O&M has proved to be a stubborn problem. Surveys have shown no substantial improvement in performance efficiency of waste water treatment facilities over the past several years. A survey of 30 treatment plants showed that poor understanding by operators of waste water treatment concepts and improper application of

Table 2-19

Municipal Water Treatment Plant Efficiencies for BOD and TSS[1]

	Percentage meeting design criteria	Primary	Lagoons	Trickling filter	Activated sludge
BOD_5	55	48	37	48	66
TSS	49	81	19	46	53

[1] BOD_5 is the amount of oxygen metabolically consumed by microorganisms in a water sample incubated at 20° C for 5 days; TSS is total suspended solids.

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

Table 2-20

Municipal Water Treatment Plant BOD Performance

Type of process		Number of plants						
		15+	5–15 (million	1–5 gallons	0–1 per day)	Unknown	Total	Percentage
Primary	S	8	8	10	21	1	48	49
	U	2	9	12	4	—	27	27
	P	2	3	5	13	1	24	24
							99	100
Lagoons	S	—	—	14	73	17	104	37
	U	—	1	5	73	19	98	35
	P	—	—	9	55	14	78	28
							280	100
Trickling filter	S	12	17	123	111	10	273	48
	U	4	23	72	72	6	177	31
	P	5	13	51	41	8	118	21
							568	100
Activated sludge	S	16	46	195	335	14	606	66
	U	14	33	84	80	5	216	23
	P	22	12	26	34	5	99	11
							921	100

S = Satisfactory
U = Unsatisfactory
P = Poor

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

Table 2-21

Municipal Water Treatment Plant Compliance with BOD and TSS Secondary Standards

Rating	Trickling filter		Activated sludge		Total	
	Number of plants	Percentage	Number of plants	Percentage	Number of plants	Percentage
S	188	30	527	55	715	45
U	177	28	178	18	355	22
P	269	42	256	27	525	33
Total	634	100	961	100	1,595	100

S = Satisfactory
U = Unsatisfactory but marginal
P = Poor

Source: U.S. Environmental Protection Agency, Office of Water and Waste Management.

these principles to plant operation were the two most frequent factors contributing to poor plant performance, as shown in Table 2–22. The study concluded that major changes are needed in operator training. EPA is exploring various approaches to this problem:

- Revising grant procedures, including possible retrieval of grant funds when performance is consistently poor

Table 2-22

Factors Limiting Performance of 30 Waste Water Treatment Facilities

Rank	Factor	Times occurred	Times ranked No. 1
1	Operator application of concepts and testing to process control	28	6
2	Waste water treatment understanding	20	4
3	Technical guidance	17	5
4	Process control testing	21	0
5	Sludge wasting capability	18	3
6	Process flexibility	16	2
7	Process controllability	20	0
8	Clarifier (secondary)	11	2
9	Sludge treatment	15	0
9	Aerator	9	2
11	Performance monitoring	15	0
12	Disinfection	10	0
12	Ultimate sludge disposal	12	0
14	Laboratory space and equipment	14	0
15	Alternate power source	13	0
15	Unit process layout	6	1
15	Policies (administrators)	7	2
18	Infiltration-inflow	11	0
18	Alarm systems	12	0
20	Plant coverage	10	0
21	Familiarity with plant needs (administration)	7	0
22	Adequacy (O&M manual)	8	0
22	Return process streams	6	1
22	Training (operations)	8	0
22	Aptitude (operations)	6	0
26	Number (staff)	7	0
26	Scheduling and recording (maintenance)	8	0
28	Flow proportion to units	6	0
28	Working conditions	7	0
28	Pay (operators)	5	0
28	Preliminary (design)	7	0
32	Plant inoperability due to weather	4	0
32	Supervision	4	0
32	Equipment malfunction	4	1
32	Productivity (operations)	5	0
32	Insufficient time on the job	5	0
32	Insufficient funding	6	0
38	Motivation (operators)	5	0
38	Flow backup	3	0
38	Level of certification	5	0
38	Housekeeping	4	0
38	Lack of program (maintenance)	4	0
38	Manpower (maintenance)	4	0
44	Industrial (loading)	2	1
44	Unnecessary expenditures	4	0
44	Lack of unit bypass	4	0
44	Plant location	3	0
48	Spare parts inventory	3	0
48	Equipment age	3	0
50	Hydraulic (loading)	2	0
50	Toxic (loading)	2	0
50	Seasonal variation (loading)	2	0
50	Process accessibility for sampling	2	0
54	Lack of standby units for key equipment	1	0

Table 2-22 (continued)

Rank	Factor	Times occurred	Times ranked No. 1
54	Quality of equipment	1	0
54	Level of education	1	0
54	Organic (loading)	1	0
54	Submerged weirs	1	0
54	Process automation control	1	0
60	Personnel turnover	1	0

Source: B.A. Heggs *et al.*, "Evaluation of Operation and Maintenance Factors Limiting Municipal Wastewater Treatment Plant Performance," *Journal Water Pollution Control Federation* 50(3):422 (1978).

- Conditioning new program grants to states on improved O&M enforcement and operating performance
- Shifting more inspectors to municipal facilities
- Conducting more technical assistance demonstrations to improve operator training
- Including operator training programs as requirements in municipal NPDES permits.

OPERATION AND MAINTENANCE OF INDUSTRIAL FACILITIES

As of June 30, 1978, EPA and the states had issued 39,142 permits to major and minor industrial and agricultural sources, and 3,076 of the major nonmunicipal sources had installed control equipment and processes to meet the 1977 "best practicable technology" requirement.[81] A growing problem facing EPA and the states is to ensure that these major industries, as well as the increasing number of minor dischargers which install controls, operate and maintain them properly.

EPA and the states have few resources to devote to O&M enforcement. State and federal enforcement personnel are heavily involved in issuing a second round of NPDES permits with stringent toxic effluent limits (permits have a 5-year life, and many are now coming up for reissuance) and in bringing enforcement actions against the remaining noncomplying dischargers. EPA and the states monitor O&M primarily by requiring dischargers to sample effluent and report the results; regular inspections, at least of major dischargers, supplement this self-monitoring program. A report several years ago for the National Commission on Water Quality concluded that the self-monitoring reports were unusable.[82] A 1978 report by EPA confirms that the problem remains a serious one; 99 percent of 106 sources whose self-monitoring programs were analyzed had deficiencies which could result in unreliable results. The deficiencies included improper flow monitoring, poor sampling techniques, and inadequate quality control in analysis.[83] Inspection programs are apparently not improving industrial monitoring.

The continuing low quality of industrial self-monitoring suggests that neither dischargers nor regulatory agencies know very much about how well installed control processes are working to remove pollutants. EPA has revised its technical manuals to improve flow measuring, sampling, and quality control procedures and has revised its inspection and monitoring forms to simplify them. The difficult task ahead is to get industrial treatment plant operators and managers, as well as the analytic laboratories, to follow them.

CEQ has recommended that EPA involve engineering firms in compliance monitoring activities as licensed water pollution auditors.[84] EPA is studying the idea.

SETTING STANDARDS OF WATER QUALITY

At the time of passage, the Water Pollution Control Act Amendments of 1972 were a new approach to pollution control. Earlier legislation, particularly the Amendments of 1965, had set goals or standards of water quality and then tried to adjust discharges to achieve that level of water quality.[85] The 1972 Act sought to achieve its goals through specific discharge requirements with specific deadlines, which were easier to enforce than the earlier goals of water quality.

The Clean Water Act of 1977 changed some deadlines for control of point sources set in the 1972 Act, but it did not change the philosophy.[86] The 1977 Act also extended funding and deadlines for areawide waste treatment planning in Section 208 of the 1972 Amendments and provided funding for control of nonpoint pollution.

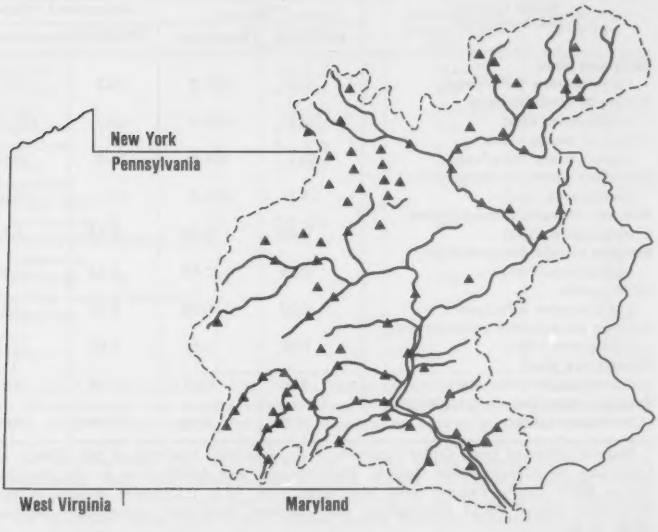
In an analysis of the effects of point discharges and nonpoint sources, it is important to consider what the quality of water might be if all human influences were eliminated. The law itself sets as an ultimate goal achieving "chemical, physical, and biological integrity of the Nation's waters." If we could eliminate all human influences, how good would the waters be? Stated in another way, what goals can we hope to achieve?

One approach to the answers is to estimate "natural" water quality statistically. This method examines a number of basins with different human influences and then extrapolates to "zero human influences." An example is the work in the Susquehanna basin of Pennsylvania by the U.S. Geological Survey in cooperation with EPA.[87] The Susquehanna River drains 27,510 square miles spanning four physiographic provinces of diverse geology. Approximately 60 percent is in forest, 31 percent is in agriculture, and 4 percent is urban.

Data on 11 water quality characteristics were compiled for 80 stations shown in Figure 2–23. Information on as many as 57 basin characteristics were compiled representing climate, topography, geology, soils, streamflow, and land use. Statistical relationships between water quality characteristics and basin characteristics were

Figure 2-23

Stream Sampling Sites in the Susquehanna River Basin



Source: Adapted from David Lystrom *et al., Regional Analysis of the Effects of Land Use on Stream-Water Quality, Methodology and Application in the Susquehanna River Basin, Pennsylvania and New York,* U.S. Geological Survey Water-Resources Invest. 78-12 (Springfield, Va.: National Technical Information Service, 1978), p. 10.

established, and estimates of "natural" water quality or "background" concentrations were then made by hypothetically removing human effects. Estimated background ranges for sediment, dissolved solids, nitrogen, and phosphorus are shown with the observed ranges in Table 2–23.

Comparisons of observed and simulated background concentrations shown in the table suggest that the impact of land use on some water quality characteristics is considerable. For example, the maximum observed nitrate and phosphorus yields are more than 10 times higher than the estimated background range. On the other hand, most of the simulated background concentrations are considerably above zero, indicating that even if all human influences could be removed, the streams of the Susquehanna basin would not be free of dissolved chemicals and sediments.

There are several reservations to be kept in mind when using the results of this study: Application is limited to the Susquehanna River basin and adjacent areas with similar conditions, the method does not provide a way to evaluate effects of major industrial sources of pollution or localized nonpoint sources, and estimated

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Table 2-23

Water Quality Characteristics in the Susquehanna River Basin

Water quality characteristics	Observed range		Simulated background range	
	Minimum	Maximum	Minimum	Maximum
Sediment yield (tons/square mile/year)	21.3	299.0	16.2	83.0
Sediment concentration (milligrams/liter)	13.3	295.0	13.1	102.0
Dissolved solids yield (tons/square mile/year)	33.4	308.0	16.9	36.0
Dissolved solids concentration (milligrams/liter)	29.0	282.0	17.4	29.6
Average nitrogen concentration (milligrams/liter)	0.40	1.59	0.15	0.46
Average nitrate concentration (milligrams/liter)	0.15	7.45	0.13	0.69
Nitrate yield (tons/square mile/year)	0.27	8.98	0.12	0.43
Average phosphorus concentration (milligrams/liter)	0.02	1.24	0.01	0.14
Phosphorus yield (tons/square mile/year)	0.03	0.35	0.03	0.03
Average phosphate concentration (milligrams/liter)	0.01	0.20	0.00	0.01

Source: Adapted from David Lystrom *et al., Regional Analysis of the Effects of Land Use on Stream-Water Quality, Methodology and Application in the Susquehanna River Basin, Pennsylvania and New York,* U.S. Geological Survey Water-Resources Invest. 78–12 (Springfield, Va.: National Technical Information Service, 1978), p. 10.

background values cannot be equated to pristine conditions free from human influences because of likely effects from air pollution, rainfall, and aftereffects of previous land use.

ATMOSPHERIC CONTRIBUTIONS

Acid rain has become an important concern among environmental agencies and scientists in Europe and North America. Acid rain and rainfall washout of other pollutants from the atmosphere influence water quality. The subject was discussed briefly in the 1977 Annual Report.[88]

Influences on Water Quality

With reservations, some general statements about the effects of atmospheric deposition on water quality can be based on data from several sources. Table 2–24 summarizes data from three studies on rates of atmospheric loading; most published data for the United States are in the ranges shown in the table. In addition to the more common substances listed in the table, atmospheric deposition also supplies metals and trace nutrients such as vitamin B–12 to waters. There are many reports available on the types and rates of loading from the atmosphere on hydrologic systems.

Table 2-24

Concentrations of Selected Substances in Atmospheric Precipitation

(milligrams per liter)

Substance	North Carolina and Virginia 1962–63	Northeastern United States 1963–68	Tennessee 1972–74
Chloride	0.1–1.1	0.4–2.1	4.0
Calcium	0.2–1.2	0.6	3.8
Sodium	0.3–1.1	0.3–1.1	1.5
Magnesium	0.1–0.2	0.1	0.7
Potassium	0.1–0.3	0.2	2.6
Sulfate	1.1–3.2	4.3	7.1
Phosphate		0.04	1.1
Nitrogen (N)			
Nitrates as N	0.5–0.2	0.3	
Nitrites plus nitrates as N			0.5
Organic N			2.5
Ammonia as N		0.2	0.4
Chemical oxygen demand			65
Manganese			0.05
Lead			0.05
Mercury			0.0009

Source: A.W. Gambell and D.W. Fisher, *Chemical Composition of Rainfall: Eastern North Carolina and Southeastern Virginia*, U.S. Geological Survey Water Supply Paper 1533–K (Washington, D.C.: U.S. Government Printing Office, 1966); F.J. Pearson, Jr., and D.W. Fisher, *Chemical Composition of Atmospheric Precipitation in the Northeastern U.S.*, U.S. Geological Survey Water Supply Paper 1535–P (Washington, D.C.: U.S. Government Printing Office, 1971); R.P. Betson, "Bulk Precipitation and Streamflow Quality Relationships in an Urban Area," presented at the American Geophysical Union Annual Spring Meeting, Washington, D.C., May 29–June 3, 1977, p. 3.

Evidence of how much of the atmospheric loading is from human pollution is slim. Twenty years ago it was estimated that human activity in the United States was adding three times more sulfur to the atmosphere than was being deposited here.[89] The excess was falling outside the continental United States. Data from a Greenland ice sheet have shown that lead, zinc, and sulfate are now being deposited at two or three times the natural rates.[90]

The deposition data in Table 2–24 should be considered in relation to stream quality. These chemicals from the atmosphere are a significant addition to those carried by streams flowing from the drainage basins. Percentages given in Table 2–25 show that atmospheric deposition accounts for at least 10 percent of the stream load of chemicals, and for some substances the atmosphere contributes all or nearly all that is carried by streams.

For nitrogen and sulfates, atmospheric contributions may exceed the amounts of material carried by the streams. For example, in a Tennessee stream, sulfates from the atmosphere were as much as 12.5 times the quantity carried from the basin by the stream.[91]

Implications for Management

Atmospheric deposition needs to be considered carefully when water quality goals are set and control of pollution from point sources

Table 2-25

Percentages of Stream Loads of Chemicals from the Atmosphere

Substance	North Carolina and Virginia 1962–63	Northeastern United States 1963–68	Tennessee 1972–74
Chloride	20	30–60	60–880
Calcium	30	20	10–460
Sodium	20	20–30	20–700
Magnesium	20	20–50	10–490
Potassium	10	70–80	30–860
Sulfate	110	90	60–1250
Nitrogen	130	120–180	210–980
Fluoride			120–430

Source: A.W. Gambell and D.W. Fisher, *Chemical Composition of Rainfall: Eastern North Carolina and Southeastern Virginia*, U.S. Geological Survey Water Supply Paper 1533–K (Washington, D.C.: U.S. Government Printing Office, 1966); F.J. Pearson, Jr. and D.W. Fisher, *Chemical Composition of Atmospheric Precipitation in the Northeastern U.S.*, U.S. Geological Survey Water Supply Paper 1535–P (Washington, D.C.: U.S. Government Printing Office, 1971); R.P. Betson, "Bulk Precipitation and Streamflow Quality Relationships in an Urban Area," presented at the American Geophysical Union Annual Spring Meeting, Washington, D.C., May 29–June 3, 1977, p. 3.

and nonpoint sources is planned. To effect stream quality levels that meet established water quality standards and criteria, then, may require elimination of virtually all controllable point sources of pollution and influences on water quality from nonpoint sources and/or reduction of atmospheric contributions through control of air pollution.

Management of both air and water quality needs legislation, standards, and regulations that apply to both air and water. We can expect to see such legislation and enforcement agencies in the future. Integrated air and water data and models of the movement of materials through the atmosphere and on the earth are a prerequisite.

Data and monitoring provide the bases for identifying needs and setting priorities for pollution control, for managing water resources, and for evaluating success of programs.

Several reviews of environmental data and monitoring programs have identified a number of problems: insufficient coverage of precipitation quality, ground water, and biological characteristics that indicate "biological integrity" as specified in the Clean Water Act; inadequate macrolevel data to assess large-scale patterns of water quality and the factors that influence it; inadequate coordination of monitoring programs and fragmentation of responsibilities among federal agencies; inadequate interpretation of data, with too much emphasis on data collection and too little on analysis; deficient monitoring in support of abatement, control, and other specific programs; lack of quality assurance in data collection and interpretation; and slow development of data systems that will provide readily accessible data of high quality.[92]

To solve these problems, the President directed CEQ to establish an interagency task force to review environmental monitoring and

data programs and to recommend ways to make the programs more effective.[93]

The task force, convened by the Council on October 5, 1977, includes some 200 representatives from all federal government departments and independent agencies concerned with environmental monitoring. It is considering environmental data and monitoring under five areas: air pollution, water, ecological and living resources, natural resources and land use, and socioeconomic issues. The work is being coordinated with the President's Reorganization Project and with staffs of congressional committees concerned with environmental data and monitoring.

In late 1978 the task force plans to begin releasing reports on coordination, monitoring design, quality assurance, data management, evaluation and reporting, and global and regional monitoring.

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CHAPTER 3

SOLID WASTES

SOLID WASTE PROBLEMS

INCREASING WASTE GENERATION

The amounts of solid wastes generated in the United States are rising each year. For the most part, they are disposed of on land. The Environmental Protection Agency estimates that industrial wastes generated in 1977 totaled about 344 million metric tons and that the rate of generation is growing about 3 percent each year.[1] Sludge and other residues from pollution control are increasing as regulation of pullutants discharged into the air and water becomes stricter. These activities are a principal constituent of industry's increase in solid wastes (Figure 3-1). Sludge from municipal waste water treatment is also increasing. It is being generated by the nation's 18,000 municipal waste water treatment plants at the rate of roughly 5 million metric tons (dry weight) per year.[2] The amount will probably double in the next 8–10 years as communities upgrade waste water treatment to meet pollution control standards.[3]

Solid wastes from residential and commercial sources were estimated at 130 million metric tons in 1976,[4] enough to fill the New Orleans Superdome from floor to ceiling twice a day, weekends and holidays included. Based on present trends and policies, the projection for 1985 is 180 million metric tons.[5]

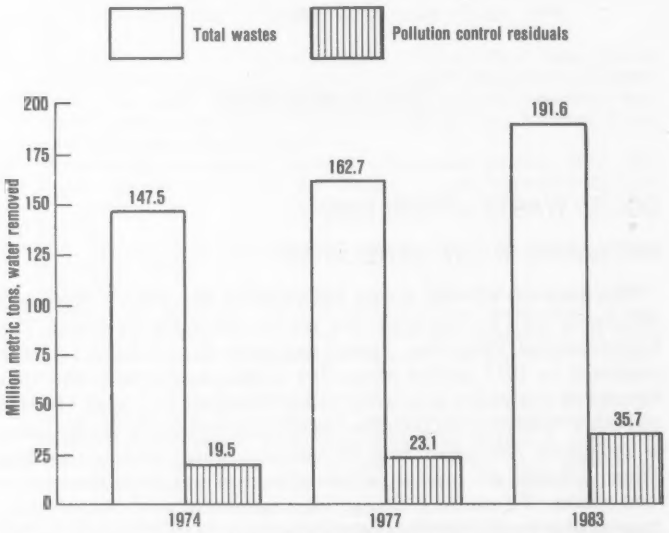
These rising rates of waste generation naturally have a magnifying influence on problems related to solid wastes, especially the costs of waste management (which totaled over $9 billion in 1977[6]), the shortage of disposal sites in urban areas, and the potential environmental and health effects of disposal. The rising waste generation rates reflect increasing use of raw materials and energy.

ENVIRONMENTAL EFFECTS

Virtually all types of wastes have potential for causing environmental problems. However, an estimated 10–15 percent of the industrial solid waste stream may be classified as hazardous,[7] that is, the wastes pose special hazards to public health and the environ-

Figure 3-1

Projected Growth in Wastes for 14 Industries[1]



[1]Batteries: inorganic chemicals, organic chemicals, pesticides, and explosives, electroplating; paint and allied products; petroleum refining; pharmaceuticals; primary metals smelting and refining; textile dyeing and finishing; leather tanning; special machinery; electronic components; rubber and plastics; and waste oil re-refining.

Source: U.S. Environmental Protection Agency, Office of Solid Waste, *State Decision-Makers Guide for Hazardous Waste Management* (Washington, D.C., 1977), p. 15.

ment unless they are properly handled, transported, treated, stored, and disposed of. Hazardous wastes may contain toxic chemicals; pesticides; acids; caustics; infectious, radioactive, flammable, or explosive substances; or other materials in sufficient amount to cause acute or chronic health effects or severe damage to the environment. Damage from land disposal of hazardous wastes can occur in several ways—ground water contamination through leaching; surface water contamination via runoff; air pollution by open burning, evaporation, sublimation, and wind erosion; poisoning through direct contact; poisoning via the food chain; and fire and explosions.[8]

In the past few years, numerous instances of degradation of surface and ground waters as a result of solid waste disposal have been documented. For example, of 50 industrial waste disposal sites sampled in an EPA study completed in 1977, 43 showed migration of heavy metals and/or organic chemicals into ground water. At 26 sites, hazardous inorganic constituents in water from monitoring wells exceeded EPA limits for drinking water.[9] Drinking water

standards currently do not cover the organic contaminants found in the study—PCBs, chlorinated phenols, benzene and derivitives, and inorganic solvents.

Extreme examples of dangerous disposal of toxic chemical wastes were recently reported by officials in New Jersey and other states attempting to enforce stricter environmental standards for disposal. Wastes have been dumped on the streets and buried in vacant lots. New Jersey marshes caught fire when buried chemical wastes leaked from corroded drums. A "midnight dumper" was found emptying chemical wastes from his tank truck into a sewer.[10]

Although data on the disposition of sludge from municipal waste water treatment are sparse, it is estimated that nationwide roughly one-half the sludge is deposited in landfills or spread on land surfaces, 35 percent is incinerated, and 15 percent is disposed of in the ocean.[11] Improper disposal can lead to pollution and adverse effects on health from the heavy metals, toxic organics, and pathogens commonly found in sludge.

Besides damaging water quality, improper land disposal of municipal solid wastes has also led to fires and explosions at landfills and adjacent areas following the lateral migration of methane generated in the landfill and its concentration to dangerous levels, the breeding of disease vectors, and air pollution from open burning.[12] Often of major concern to local residents are the nuisance factors of poorly managed sites—the general appearance, the litter, odors, traffic congestion.

Upgrading land disposal practices is an immense task. Roughly there are 20,000 general refuse sites, 23,000 sludge disposal sites, and more than 100,000 surface impoundments for industrial wastes.[13]

SHORTAGE OF SITES FOR WASTE MANAGEMENT FACILITIES

Finding sites for processing and disposal of the growing burden of wastes is increasingly difficult. Land is harder to find and prices are rising, especially in urban areas; state environmental standards are becoming stricter; and federal environmental criteria for disposal facilities are being developed. The greatest constraint, however, is public opposition to proposed sites. Aversion to waste management operations has blocked establishment of numerous facilities that would have been acceptable from environmental and economic viewpoints. Numerous localities have ordinances against disposal of wastes from other jurisdictions, and some states restrict importation of wastes from other states. EPA has opposed restrictions (except those imposed for reasons of safety) on the movement of wastes because they can seriously impede regional planning and economic use of facilities. A recent development on this issue was the Supreme Court decision in June 1978 striking down New Jersey's law that banned importation of most out-of-state wastes; the law was

declared unconstitutional because it interfered with interstate commerce.[14]

Even with optimal recycling and recovery of resources from wastes, some residues will remain, and disposal facilities must be made available. Clearly, public participation and education must be integrated into solid waste management planning so that citizens can feel confidence in the necessity and soundness of proposed operations. Whether these measures can reduce opposition enough to permit all the sitings that are needed is uncertain.

RESOURCE CONSERVATION AND RECOVERY ACT

The Resource Conservation and Recovery Act of 1976 [15] called for a national effort to deal with solid waste problems. Solid wastes are broadly defined in the Act to include waste solids, sludges, liquids, and contained gases; excluded are solid and dissolved materials in domestic sewage, return irrigation flows, and industrial discharges subject to permits under Section 402 of the Federal Water Pollution Control Act and certain radioactive wastes covered by the Atomic Energy Act of 1954. The main goals are to control solid waste management practices that can endanger public health or the environment and to promote resource conservation and recovery. The key provisions of RCRA for achieving these goals are:

- Federal financial and technical assistance to state and local governments for development of comprehensive state solid waste management programs that include environmental controls on all land disposal of solid wastes
- Regulation of hazardous wastes from point of generation through disposal
- Resource recovery and conservation activities
- Regulatory control of hazardous wastes by EPA if states do not establish control programs that meet federal standards
- A Cabinet-level interagency study of resource conservation policies
- Public participation in the development of all regulations, guidelines, and programs under the Act
- Research, demonstrations, studies, and information activities related to a wide range of solid waste problems.

Appropriations for EPA to implement RCRA were $17.3 million in 1977 and $39.8 million in 1978, shown in Table 3–1. The President's budget called for $71.9 million for 1979.

STATE AND LOCAL PROGRAMS

Solid wastes are managed primarily by local governments and by the private sector. Local governments or their contractors collect

Table 3-1

Appropriations under RCRA

(million dollars)

Recipient	1977	1978	1979[1]
Environmental Protection Agency			
Office of Solid Waste	$ 8.2	$14.7	$11.6
Regional Offices	1.8	2.2	7.1
Office of Research and Development	4.2	7.6	10.9
Office of Enforcement	0.1	1.0	1.1
Grants to states	2.9	14.3	26.2
Grants to urban areas for resource recovery	—	—	15
Total	$17.3	$39.8	$71.9

[1] Requested in the President's budget.

Source: U.S. Environmental Protection Agency, Office of Solid Waste, Solid Waste Fact Sheet (Washington, D.C., May 1978).

and dispose of residential and some commercial wastes. Industrial and other wastes are managed by the generators or by private waste management services.

The Solid Waste Disposal Act of 1965 [16] first authorized federal aid to states for solid waste management planning in recognition of the problems related to solid waste disposal and the need for statewide and regional planning. Until that time there was virtually no state or federal involvement in solid waste management. Since then the number of state employees working full time in solid waste management has increased from fewer than 10 in 1965 to 1,000 in 1977.[17]

For fiscal year 1978, federal grants totaling approximately $14.3 million were distributed to the states for their planning and development responsibilities under RCRA—development of environmental controls for land disposal of solid wastes, regulation of hazardous wastes, and resource conservation and recovery activities. Federal grants in fiscal year 1977 were $3 million. The federal government is also offering more technical assistance to state and local governments; panels of experts, including federal, state, and local government employees and consultants, are now available through EPA regional offices.

All states now have some authority over disposal of municipal solid wastes, and some have permit systems for disposal. Several states have advanced programs in hazardous waste management (e.g., California, Texas) or resource recovery (e.g., Connecticut, New York), but most do not yet have substantial programs in these areas. In many states and local areas, authority is not sufficient to carry out the full program envisioned in RCRA.

According to that Act, state solid waste management plans approved for federal funding must

- Define boundaries for regional solid waste management and identify state, regional, and local agencies responsible for implementing the state plan

- Prohibit new open dumps and other environmentally unacceptable disposal facilities and require that all solid wastes either be used for resource recovery or be disposed of in an environmentally sound manner
- Set compliance schedules for closing or upgrading all existing facilities that do not meet environmental criteria
- Develop regulatory powers needed to implement the state plan
- Remove impediments to local long-term contracts for supplying solid wastes to resource recovery facilities (long-term contracting by cities is prohibited in some states)
- Include resource recovery, conservation, and disposal programs necessary for environmentally sound management.

Guidelines for identifying regional boundaries and the agencies responsible for solid waste management were issued by EPA in May 1977.[18] Many state and local governments have identified management areas, but often on a temporary basis because boundaries may change through the ensuing planning process.

EPA guidelines to assist in developing and implementing the state solid waste plans, required under Section 4002 (b), are scheduled to be issued in December 1978.

CONTROLLING LAND DISPOSAL

LAND DISPOSAL CRITERIA

On February 6, 1978, EPA issued proposed regulations that define the minimum criteria by which disposal sites will be classified as environmentally acceptable. The proposed criteria considered effects of disposal on surface water, on ground water, and on air, control of disease vectors, safety, and protection of wetlands and other environmentally sensitive areas. The application of sludge and other solid wastes to land used for food chain crops would have to meet additional criteria for controlling risks from cadmium, pathogens, and pesticides and other persistent organics that are present in some wastes. The land application of certain wastes would also have to be managed so that neither humans nor animals raised for milk would directly consume food contaminated by the freshly applied wastes.

Because these criteria apply to land disposal and application of municipal sludge, they will partially fulfill requirements of Section 405(d) of the Federal Water Pollution Control Act,[19] which calls for guidelines to be issued on the use and disposal of municipal sludge. Additional guidelines for sludge, covering incineration and pyrolysis, giveaway and sale programs, and other options, will also be developed under Section 405(d).

EPA expects to publish the land disposal criteria in final form by the end of 1978 following public hearings, meetings with interested groups, and evaluation of the comments.

IMPLEMENTATION

RCRA requires EPA to publish, within 1 year of publication of the land disposal criteria, an inventory of all U.S. facilities that do not comply with the criteria. All new facilities must comply, and any existing facility not in compliance must be closed or upgraded according to a state-established schedule. The schedule must include an enforceable sequence of actions leading to full compliance by the listed facilities within a reasonable time, not to exceed 5 years from the date of publication of the inventory.

Evaluations for the inventory will be carried out by the states with technical and financial assistance from EPA. Because of the number of sites and because evaluation involves extensive technical determinations, a single year may not be enough time. Plans are being made to phase the inventory process over a longer period to permit adequate evaluation of disposal facilities.

Under RCRA, there are several mechanisms for enforcing compliance with the disposal criteria: state actions using the regulatory powers included in the state solid waste management plans, suits brought by private citizens to enforce the law, and intervention by the EPA Administrator through the courts upon receipt of evidence that an imminent hazard exists because of the handling, storage, treatment, transportation, or disposal of solid wastes.[20] The Act does not explicitly require states to enforce the criteria, but they are not eligible for federal financial aid for developing their solid waste management programs if their plans do not provide for such enforcement.

REGULATING HAZARDOUS WASTES

RCRA requires comprehensive ("cradle to grave") regulation of hazardous wastes. The key provisions are for development of criteria for identifying hazardous wastes, publication of characteristics of hazardous wastes and of lists of particular hazardous wastes, institution of a manifest system to track wastes from the point of generation to the point of disposal, and organization of a permit system based on performance and management standards for hazardous waste treatment, storage, and disposal facilities. With these controls, all individuals or industries generating waste will determine whether the waste is hazardous according to the published characteristics and lists. If it is, they must either obtain a permit to manage it on their property or ship it to a permitted treatment, storage, or disposal facility. In the latter case, a manifest containing basic information about the waste must accompany the shipment. In either case, all treatment, storage, and disposal operations must meet the minimum standards developed.

RCRA requires the regulations to be promulgated by April 1978, but the extensive evaluations, discussions, and reviews have led to unavoidable delay (see Table 3–2). The regulations will become

Table 3-2

RCRA Regulations and Guidelines Issued or in Preparation, June 1978

Section	Description	Schedule for issuance[1]
1008	Solid waste management guidelines	The first guidelines to be on land disposal practices, to be issued in 1979 after the land disposal criteria are determined (Section 4004)
3001	Identification and listing of hazardous wastes	Publication in proposed form planned for November 1978
3002	Standards for generators of hazardous wastes	Publication in proposed form planned for November 1978
3003	Standards for transporters of hazardous wastes	Proposed regulations published April 28, 1978
3004	Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities	Publication in proposed form planned for November 1978
3005	Permits for treatment, storage, or disposal of hazardous wastes	Publication in proposed form planned for November 1978
3006	Guidelines for development of state hazardous waste programs	Proposed guidelines published February 1, 1978, final planned for September 1978
3010	Notification system regulations	Proposed guidelines published July 11, 1978, final in November 1978
4002(a)	Guidelines for identification of regions and agencies for solid waste management	Interim guidelines published May 16, 1977
4002(b)	Guidelines for state plans	Publication in proposed form planned for August 1978, with final guidelines in December 1978
4004	Criteria for classification of disposal facilities	Proposed regulations published February 6, 1978, final regulations about December 1978
6002	Guidelines for procurement practices	First of series planned for 1979
7002	Prior notice of citizen suits	Proposed regulations published July 20, 1977, final regulations published October 21, 1977
7004	Public participation guidelines	Interim guidelines published January 12, 1978
Financial assistance provisions	Interim regulations to implement the Resource Conservation and Recovery Act of 1967, grants and other financial assistance	Interim regulations published October 20, 1977

[1] Schedules for issuance of guidelines and regulations in preparation are subject to change. Final regulations under Sections 3001-3005 will be published at one time because they must be consistent and coordinated; it will take place 3-5 months after publication of proposed rules under these sections.

Source: U.S. Environmental Protection Agency, Office of Solid Waste.

effective 6 months after promulgation. They will be administered by EPA and by state programs authorized by EPA.

Fully authorized state hazardous waste regulatory programs must be the equivalent of the federal program, must be consistent with the federal program and programs of the other states, and must provide for adequate enforcement. Because most states would not be able to qualify for full authorization at the outset, RCRA provides for a 2-year interim authorization, effective 6 months after promulgation of the hazardous waste identification regulations, of state programs "substantially equivalent" to the federal program. EPA anticipates that at least 30–40 states will qualify for interim authorization in fiscal year 1979.

RESOURCE RECOVERY AND REDUCTION OF WASTES

The most fundamental ways to lessen the environmental damage from waste disposal are to generate less waste and to recover and reuse valuable resources from wastes. Both approaches save energy and materials while reducing pollution.

Unfortunately, our national attitudes, habits, and policies are based on high consumption of virgin resources and have often been inimical to recycling of resources, particularly those found in household and commercial trash. As a result, our municipal solid waste generation is high—about 1,300 pounds per person per year—and the rate of resource recovery is low—about 7 percent.[21] It has been estimated that the amount recovered could be tripled [22] through

Recycling household and municipal trash should help to save energy and materials while reducing problems of disposal.

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source separation alone, that is, setting aside of recyclable materials such as newspapers, glass, and metal for separate collection or delivery to recycling centers.

With increased land disposal and hazardous waste management, controls which will in turn increase disposal costs, resource recovery and waste reduction should become more economically attractive. Traditional but environmentally unacceptable disposal practices, which are typically cheap because the costs of environmental damage are not included, have put resource conservation approaches at a competitive disadvantage. When environmental protection costs are included in waste disposal charges, conservation practices will be seen as a better value.

Positive federal action can also help to make resource recovery a paying proposition. The Department of Commerce is charged by RCRA with the duty to encourage commercialization of resource recovery by providing accurate specifications for recovered materials, stimulating markets for the materials, promoting proven technology, and providing a forum for the exchange of technical and economic data.

ENERGY RECOVERY

Increasing costs of land disposal and rising energy prices have already created lively interest and activity in energy recovery from municipal solid wastes. The systems of greatest current interest are:

- Direct combustion of solid wastes in waterwall combustion units (furnaces with walls lined with tubes through which water flows, absorbs the heat, and turns to steam)
- Use of prepared solid wastes as a supplementary fuel in existing fossil fuel boilers
- Conversion of solid wastes to liquid or gaseous fuel forms through pyrolysis (heating in an oxygen-deficient atmosphere)
- Direct combustion of solid wastes in small modular incinerators
- Thermal codisposal of solid wastes and sewage sludge.[23]

The first sophisticated U.S. waterwall combustion facility, patterned after European designs, was constructed in 1971 in Braintree, Massachusetts. Shortly thereafter, plants were built in Chicago and in Harrisburg, Pennsylvania. More recently, waterwall combustion units were constructed in Nashville and in Saugus, Massachusetts. Other units are planned for Westchester County, New York; northeastern Massachusetts; St. Paul, Minnesota; Jefferson County, Kentucky; and Pinellas County, Florida.

Direct combustion of solid wastes as a supplement to fossil fuel in an existing boiler was first tried out in St. Louis. With an EPA demonstration grant, the city operated a test facility from 1972 to 1976 using prepared solid wastes to supplement pulverized coal in a suspension-fired steam-electric boiler. The test was generally successful. Several other cities have begun constructing similar facilities,

and plants are now operating in Ames, Iowa, Milwaukee, and Baltimore County. Plants are under construction in Bridgeport, Connecticut; Chicago; Dade County, Florida; Lane County, Oregon; and Albany, Hempstead, Niagara Falls, and Monroe County, New York.

Pyrolysis of municipal solid wastes developed in an effort to convert solid wastes into a more marketable fuel. Ideally it would be easily transported to distant users, could be easily stored for use when needed, and would be compatible, in effect interchangeable, with conventional fuels.

Despite 10 years of extensive work, pyrolysis is still not ready for commercial use. Although there are 50 or more organizations working on different pyrolysis systems, only three systems have evolved to the demonstration stage in this country.[24] (A 200-ton commercial plant is in the startup stage in Luxembourg.) The largest, with a design capacity of 900 metric tons of solid wastes per day, is the rotary kiln pyrolysis reactor built in Baltimore with financial assistance from EPA. Although it has operated intermittently since 1975, the plant has been plagued with mechanical problems, and its commercial designer has withdrawn from the project. The city of Baltimore is making major modifications to the plant, attempting to improve performance.

A smaller pyrolysis plant, with a capacity of 180 metric tons daily, was built with EPA assistance in San Diego County and is currently going through startup operations. Another plant of similar size in South Charleston, West Virginia, is undergoing testing.

Small modular incinerators are shop-fabricated units that have been in widespread use for many years but have only recently been adapted for heat recovery and municipal solid wastes. Ranging in size from 1 to 30 tons per day, they were historically used in industrial, commercial, or institutional applications. More recently multiple units with total capacities of 20–100 tons per day have been installed for municipal operations. These units produce steam which is used by a single adjacent facility. Because they are shop fabricated, their construction onsite is quick and simple, requiring only minimal skilled labor. Capital and operating costs are low enough that they are feasible for communities as small as 10,000–15,000 people. Even smaller communities may find this incinerator practical when it can dispose of both municipal wastes and the wastes generated by the plant using the steam.

In codisposal systems, the heat from the combustion of solid wastes is used to dry sewage sludge to the point at which it will burn without auxiliary fuel. The excess energy can be used to power the waste water treatment plant producing the sludge. Codisposal is practiced in Europe and has been demonstrated to a limited extent in this country. The possibility of alleviating two disposal problems while producing energy makes it an attractive approach. Facilities are planned or are under construction in Concord, California;

Duluth; Glen Cove, New York; Harrisburg, Pennsylvania; and Memphis, Tennessee.

The first resource recovery systems were seized upon as a panacea that would "turn garbage into gold." But they were largely untried technologies based on very limited experience with municipal solid wastes as feedstock. As more plants come into operation, expectations of what the systems can do are more realistic.

There is also increasing recognition of the importance of institutional factors. Prior to plant construction, cities must have or be able to obtain expertise in the special procedures required and have adequate funds to carry them out. These procedures involve performing feasibility studies, evaluating systems and types of contracts, writing requests for proposals and evaluating the responses, finding financing, securing markets for the recovered products, ensuring a reliable volume of wastes (which may involve regional arrangements), and having a knowledge of all legal restrictions.

Until recently, federal financial support for resource recovery was generally in the form of EPA demonstration grants (total awards during 1970–75 were about $25 million) and in research and development projects funded by the Department of Energy and EPA ($10–15 million committed thus far).

To encourage more rapid development of energy recovery from muncipal and industrial wastes, the Department of Energy Act of 1978 [25] authorized federal loan guarantees covering a maximum of $300 million in indebtedness for construction of demonstration facilities.

Pending congressional approval, in fiscal year 1979 EPA will provide grants to cities for feasibility studies and other planning and development tasks for resource recovery plants and source separation programs. President Carter announced his request for $15 million for these grants in his Urban Policy Message of March 1978.[26] The grants would enable cities to hire a project manager, staff, and consultants. EPA expects to request proposals in October 1978.

EPA will continue to provide technical assistance in resource recovery through regional seminars and the Technical Panels Program required under RCRA.

SOURCE SEPARATON AND MATERIALS RECOVERY

Of the approximately 9 million tons of materials recovered annually from municipal solid wastes (90 percent is waste paper), most is recovered through source separation. One type of source separation program, the separate collection of recyclable materials from households, was the subject of an EPA telephone survey in December 1977. Communities known to have a separate collection program, state solid waste agencies, and EPA Regional Offices were contacted. The survey found 216 communities with separate collection programs. All collected newspaper separately; 35 had separate collections

for other recycleables as well.[27] A similar survey in 1974 identified 134 programs.[28]

Another kind of source separation program is the neighborhood recycling center. EPA estimates that there are about 3,000 centers operating in the country.[29] In Portland, Oregon, for example, a system of centers is run by the Portland Recycling Team, a nonprofit organization. PRT recovers approximately 1,000 tons of material per month through seven permanent recycling centers which are open and staffed every day and have 24-hour dropoff service. The centers accept glass, cans, nonferrous metals, used motor oil, newspapers, mixed wastepaper, and other materials.

There is increasing awareness of the planning and organizational requirements for successful recycling programs. To share information and experiences, recyclers have formed associations in California, Colorado, Michigan, New York, Oregon, and Washington.[30]

EPA Guidelines for Source Separation for Materials Recovery,[31] issued in April 1976, require the recovery of high-grade paper, newsprint, and corrugated boxes from designated federal facilities. The high-grade fraction in office buildings ranges from 35 to 75 percent. As of March 1978, some 115,000 federal employees at 90 facilities participated in the paper recovery program; the number is expected to increase to 250,000 by the end of the year and to 500,000 by 1980. Revenues totaled approximately $150,000 in 1978. The Guidelines have been adopted by 15 states and hundreds of municipal and county governments. Several hundred private companies have begun recycling office paper in recent years.[32]

In the secondary materials markets, the most notable development was the rising demand for newspaper during the fall and winter of 1977–78 for use in the expanding insulation industry. Meanwhile, the market for white ledger wastepaper fell because of a temporary worldwide excess of pulp. The demand for ferrous scrap declined because of the depressed steel and copper industries (a large proportion of recovered steel cans is used for copper precipitation).[33]

FEDERAL PROCUREMENT

One section of RCRA has as an objective the creation of a "demand pull" for secondary materials through the power of government purchasing.[34] All procuring agencies (including the Government Printing Office), states, local governments, and contractors using federal funds must "procure items composed of the highest percentage of recovered materials practicable consistent with maintaining satisfactory levels of competition." Exceptions may be made only when such materials do not meet reasonable performance standards, are available only at an unreasonable price, or are not available within a reasonable period of time. EPA expects to issue the first guidelines on procurement of paper by early 1979.

INDUSTRIAL WASTE EXCHANGES

Resource recovery and waste reduction in industry are being stimulated by the rising costs of materials, energy, and waste management. A recent development is the establishment of information exchanges or clearinghouses on wastes available from industrial firms; the clearinghouses bring together waste owners and prospective buyers or users. In the past, firms generally focused only on possible use of wastes within their own industries; the exchange allows them to exploit opportunities for using wastes from many others. Typical wastes that are offered and sought through the exchanges are clean acid wastes for pickling, fertilizer manufacturing, and electroplating; alkali wastes for scrubbing and acid neutralization; high calorific value organics, such as solvents; and specialty wastes that contain valuable metals.

Waste exchanges began in Europe in 1972. In 1976, the St. Louis Industrial Waste Exchange opened in the United States; it continues to be active. At least 15 more exchanges have been set up since, mostly in the East, by chambers of commerce, trade associations, environmental groups, and others.[35] Although waste trading does not promise to be a major solution to waste management problems, it is one more option that industries can now consider.

BEVERAGE CONTAINER DEPOSITS

Six states—Oregon, Vermont, Maine, Michigan, Connecticut, and Iowa—have laws requiring deposits on beer and carbonated soft drink containers. The Massachusetts Legislature also appears near enactment of such a law. The purpose of the deposits is to give consumers a direct financial incentive to return beverage containers for reuse or recycling rather than adding to the burden of municipal solid waste collection and disposal or littering.

The issue of federal beverage container deposit legislation was the first to be thoroughly reviewed by the Federal Interagency Resource Conservation Committee established under RCRA. The Committee consists of the EPA Administrator who serves as Chairman, the Secretaries of Commerce, Interior, Labor, and Treasury, the Chairman of the Council on Environmental Quality, a representative of the Office of Management and Budget, and two nonstatutory members representing the Council of Economic Advisers and the Department of Energy. The Committee has a mandate to investigate, over a 2-year period, a variety of economic incentives and disincentives, taxes, subsidies, regulations, and other policies affecting resource conservation.

The beverage container deposit issue was investigated first because of legislation pending in the Congress. The Committee found that mandatory deposits are effective in reducing litter and do make a dent in the waste stream. But the Committee deferred a decision on recommending deposit legislation until the relationship between

deposits and the more general concept of solid waste disposal charges and other broader policies are clarified.

In its report to the President and the Congress on January 23, 1978, the Committee said:

1. The imposition of mandatory deposits is an effective means for reducing litter associated with beverage containers.
2. Up to two percent of the solid waste stream could be eliminated by the imposition of mandatory deposits.
3. Product charges, which are currently under consideration by the Committee staff, might substantially reduce problems associated with the solid waste stream and encourage recycling, albeit with a lesser impact than mandatory deposits on litter resulting from beverage containers.
4. Upon completion of additional studies, the Committee will make a recommendation, at the earliest possible date, on the desirability of Federal mandatory deposit legislation. When the current studies on product charges are completed, the Committee will make a recommendation with respect to a legislative proposal on product charges . . . .[36]

The report continued with specific recommendations for legislation, for example, a 5-cent minimum deposit, first application of the deposit to the distributor-wholesaler, and a 2-year phasein period between enactment and effective date. Detailed estimates of benefits and costs to be expected from deposit legislation are included.

The EPA Guidelines for Beverage Containers,[37] issued September 21, 1976, require a refundable 5-cent deposit on all containers for beer and soft drinks sold at federal facilities. The Department of Defense has tested the guidelines at 10 military bases, and the results are being analyzed to determine the feasibility of implementation. The National Park Service began implementing the Guidelines throughout its system in July 1977. EPA is tracking progress in implementation through a series of reports required of federal agencies.

THE SOLID WASTE DISPOSAL CHARGE

The Resource Conservation Committee is planning to issue a report on the solid waste disposal charge (or product charge) in the fall of 1978. The solid waste disposal charge is a tax or fee imposed on the material content of products that will enter the municipal solid waste disposal system. The charge is based on the costs of collecting and disposing of the products. Under most proposals, there is no charge for recycled material contained in products because recycling saves municipal solid waste costs. The charge is intended to encourage more efficient use of materials, because the costs of waste disposal are borne by producers and consumers of products. It is also expected to increase the demand for recycled materials and therefore encourage recycling. Most proposals would return the revenues raised by the fee to consumers or municipalities.

Major issues under review include: what products should be subjected to the charge, how to determine the charge levels, whether to adjust the charge according to geographic variations in disposal costs, where in the production and distribution system the charge should be collected, whether there should be adjustments or credits for resource recovery, and how to allocate the revenues collected.

PUBLIC PARTICIPATION AND EDUCATION

Public participation is being encouraged and provided for in the development of all the programs, guidelines, and regulations under the RCRA. Over 100 public hearings and meetings have been held on proposed regulations and guidelines affecting hazardous waste management and land disposal, policies before the Resource Conservation Committee, and other issues. Guidelines on public participation, applicable to state and local governments receiving financial aid under the Act as well as to EPA components, were issued on January 12, 1978.[38]

If citizens are to participate constructively in solid waste management programs and give the support that is essential to establishing necessary disposal facilities or developing source separation programs or other projects, they need to understand the issues. Educational efforts are required of EPA under Section 8003 of RCRA. In addition to developing and distributing information materials, EPA has expanded its support of educational programs conducted by environmental and civic groups, unions, and other organizations. For example, with EPA grant support the National Wildlife Federation is conducting public forums in six states on the hazardous waste regulatory program, and the Izaak Walton League is holding workshops on sludge management issues.

RESEARCH AND DEVELOPMENT

Numerous projects to study solid waste disposal problems and to develop technology for dealing with them are being funded by EPA. Many of the studies focused on the impacts of land disposal on ground water quality. Technology for detecting, minimizing, containing, treating, and eliminating the release of pollutants from wastes disposed of on land is under evaluation. Various means of detoxifying hazardous wastes, immobilizing the hazardous constituents, and using hazardous and other wastes as resources are also being evaluated. Studies and demonstrations of the land application of municipal waste water treatment sludge are focused on health and environmental effects, methods of application, and public acceptance. Cost studies are being done to determine the economic impacts of the various waste management techniques. All these activities provide support for guidelines and criteria development and for technical assistance.

Development efforts in resource recovery from municipal wastes are concentrated on energy recovery. The Department of Energy and EPA are supporting studies, demonstrations, and evaluations of numerous waste-to-energy processes. Continued development of processes for cofiring wastes with coal, improved pyrolysis, and waste bioconversion is a current objective. The coprocessing of sludge and solid wastes for disposal and heat recovery is being investigated. EPA is conducting evaluations of small modular incinerators, the refuse-derived fuel plants in Ames, Iowa, and Chicago, and large waterwall combustion units in Europe.

LOOKING AHEAD

The federal guidelines, regulations, and systems prescribed by RCRA for solving the major environmental problems related to solid wastes appear to be falling into place, if rather more slowly than called for in the law. The emphasis will soon shift to implementation at state and local levels, where the real action will take place in ending environmentally unacceptable solid waste disposal practices. It is altogether likely that lack of funds, disposal sites, and public support will hold up progress in some areas. RCRA challenges the abilities of state and local government to plan and work together for efficient use of resources and disposal capacities and to incorporate public education and participation.

In the area of resource conservation, further development of energy recovery seems assured; not only is there intense interest and activity in the field, but the DOE loan guarantee program and the proposed EPA grants to cities for planning and development vastly increase the level of federal support.

The rapid growth of office paper recycling is a manifestation of the potential for materials recovery from postconsumer wastes. Yet the vagaries and weakness of the secondary materials markets limit exploitation of the potential. The Resource Conservation Committee provides a valuable opportunity to develop and place before the nation well-considered policies that will increase recycling and reduce waste.

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CHAPTER 4

TOXIC SUBSTANCES

The Toxic Substances Control Act of 1976 (TSCA) gave the government a new mandate and broad new authority to gather information on the potential of chemicals to damage human health and the environment and to control them where necessary. The result is more awareness on the part of government, industry, scientists, and the public of the problems of toxic chemicals and heightened expectations for correction and prevention.

But bringing toxic substances under control is more easily said than done. The number of chemical substances and the size of the chemical industry suggest the magnitude of the task. In November 1977, the registry of chemicals maintained by the American Chemical Society listed 4,039,907 distinct chemical compounds—and the registry includes only chemicals reported in the literature since 1965. The list has been growing at a rate of 6,000 per week.[1] The number of chemicals currently in commercial production in the United States may be as high as 70,000; 50 are produced in quantities greater than 1.3 billion pounds per year.[2] One hundred and fifteen thousand establishments are involved in the production and distribution of chemicals,[3] and the business is worth $113 billion per year, about 7 percent of the nation's GNP.[4]

These numbers suggest two points. One is the astonishing dependence of modern life on chemicals that are synthesized or isolated from natural products. A second is the staggering task that faces industry and government in regulating the production and distribution of so many different entities. Many, indeed probably the majority, of the tens of thousands of chemicals in commerce are innocuous, and their benefits are great. Yet our ignorance about them is also great.

The continuing discovery of previously unsuspected hazards from one chemical or another underscores the point. The environmental and health effects of most of these substances have not been adequately studied. Testing has been confined largely to acute toxic effects, and knowledge of environmental transport and fate, biological pathways, and chronic long-term effects is scant. A shortage of laboratory facilities and professionals trained in toxicology, industrial hygiene, pathology, and other such disciplines is a bottleneck

in the flow of needed information. The lack of a comprehensive system for storing and analyzing information makes it difficult to use the data that do exist.

Hardly a week goes by, it seems, without another report of a newly discovered hazard—definite or suspected—in the marketplace or the workplace, in the air, water, or some other part of the environment. Consider the following examples from the past 2 years:

- PCBs (polychlorinated biphenyls), a class of industrial chemicals that are similar in structure to DDT, are appearing in fish at unacceptable levels in fisheries across the nation. Indiana and Pennsylvania joined Connecticut, New York, and the Great Lakes states this year in restricting the consumption of fish caught in local waters because of contamination by PCBs. TSCA expressly prohibits the sale of PCBs after July 1, 1979, but these persistent toxic chemicals will still remain in sediments of streams, lakes, and coasts, and a substantial portion of PCBs contained in capacitors and transformers has not yet entered the environment.
- Preliminary findings from laboratory tests indicate that some diatoms, algae, and some phytoplankton (which are the foundation of the marine food chain) are sensitive to ultraviolet light and may be endangered if worldwide emissions of ozone-depleting substances continue.[5]
- People living near roads and highways may face increased risks of developing cancer, as much as nine times the normal risk, as a result of their exposure to polycyclic aromatic hydrocarbons emitted by automobiles.[6]
- Colorado florists exposed to flowers containing up to 22 parts per million of Systox, a very toxic organophosphate pesticide, reported such neurologic symptoms as headache, blurred vision, and muscle weakness. Subsequent samples of flower imports in Miami, where 96 percent of imported cut flowers enter the country, disclosed potentially toxic levels. Imported flowers must meet stringent Department of Agriculture plant disease and pest importation restrictions but no pesticide or chemical residue limitations.[7]
- Benzene, which is implicated in causing leukemia, was recently regulated for occupational exposure and is on EPA's list of hazardous air pollutants. It is still found at hazardous levels in consumer products. A recent study found that typical exposure of a householder using benzene to strip furniture would exceed not only the current standard for occupational exposure but also the old standard established before benzene's leukemogenic properties were taken into account. Benzene is also found in such consumer products as carburetor cleaner, denatured alcohol, rubber cement for tire patch kits, and arts and crafts supplies.[8]

- According to a survey of 4,636 plants employing a total of 985,000, one of four U.S. citizens is exposed in the workplace to some substance capable of causing death or disease.[9]
- A 2-year study conducted by the Environmental Defense Fund and the New York Public Interest Research Group has found that the Hudson River is contaminated with a complex spectrum of toxic substances such as PCBs, benzene, xylene, cyclohexane, tetrahydrofuran, toluene, and chloroform, all of which pose a health threat to the 150,000 people upstate who drink River water.[10]
- Asbestos fibers are found in the lungs of virtually the entire U.S. population, according to researchers at the University of Chicago. Asbestos bodies (fibers that have acquired an iron-containing coating) are present in almost all (96 percent) urban dwellers. There is concern that public exposure to asbestos generally may be increasing, despite Occupational Safety and Health Administration and Environmental Protection Agency standards for occupational exposure and air emissions, because mining and consumption of asbestos have increased from 300,000 tons in the 1920's to more than 5 million tons in 1974.[11]
- "Highly significant" levels of lead and copper have been measured in the Raritan and lower New York Bays. Pollution by these and other heavy metals, including mercury, chromium, cadmium, and zinc, may be coming from various sources, including sewage sludge from the New York metropolitan area, dredge spoils, and large amounts of municipal and industrial wastes carried into the Bays by tributaries. Recent concerns are that reductions in species quantity and diversity may pose serious threats to the area's commercial fishing industry.[12]

In addition to these examples, the National Institute of Occupational Safety and Health issued seven *Current Intelligence Bulletins* during the past year calling attention to previously unknown or unrecognized information on occupational hazards. Information from the NIOSH bulletins is summarized in Table 4–1. The National Cancer Institute, which has been testing chemicals on a large scale since 1968 to evaluate their ability to induce cancer, began a technical report series in 1976 with full documentation of the results of long-term animal studies. Of the 29 drugs, pesticides, and other chemicals selected for testing on the basis of their biological activity and reported on as of March 1978, 19 appeared to be carcinogenic under test conditions.

The litany could go on. It is significant that in many cases even when the toxic properties of a chemical are relatively well known, technical obstacles, industry resistance, bureaucratic inertia, and legal complexities must be overcome before the knowledge is translated into protective measures. For example, uncertainty over jurisdiction may seriously hinder control of toxic chemicals. Regulation under TSCA is only one of several ways to reduce the risks from chemical substances; many other laws, such as the Clean Air Act

Table 4-1

NIOSH *Current Intelligence Bulletins* on Occupational Hazards

Compound	Use	Number exposed	Primary hazard	Current OSHA standard
Trimellitic anhydride	Curing agent for epoxy and other resins, in vinyl plasticizers, paints and coatings, agricultural chemicals, dyes and pigments, pharmaceuticals, etc.	20,000	Noncardiac pulmonary edema (excessive fluid in the lungs)	None
2,4-Diaminoanisole	Hair and fur dyes	400,000 cosmetologists, etc.	Cancer	None
Tetrachloroethylene (perchloroethylene)	Solvent in dry cleaning, fabric finishing, metal degreasing, other uses	500,000	Cancer	100 pounds per minute in air, 8-hour average
Acrylonitrile	Production of acrylic fibers	125,000	Cancer	Emergency temporary standard: 2 pounds per minute in air, 8-hour average
Ethylene thiourea	Production of rubber, a contaminant in widely used fungicides	3,500	Cancer, birth defects	None
Ethylene dibromide	Lead scavenger in fuels, fumigants, chemical manufacturing	NA	Cancer	20 pounds per minute, 8-hour average
Disulfiram	Prescription drugs, insecticides, other uses	70,000 workers	Toxic interaction with other chemicals	NA
Certain benzidine-derived dyes	Paper, petroleum, rubber, plastics, leather, banking, other industries	NA	Cancer	NA

NA = Not available

Source: U.S. Department of Health, Education, and Welfare, National Institute of Occupational Safety and Health, *Current Intelligence Bulletins:* No. 21, *Trimellitic Anhydride (TMA)*, February 3, 1978; No. 19, *2,4-Diaminoanisole*, January 13, 1978; No. 20, *Tetrachloroethylene (Perchloroethylene)*, January 20, 1978; No. 18, *Acrylonitrile*, July 1, 1977; No. 22, *Ethylene Thiourea*, April 11, 1978; No. 23, *Ethylene Dibromide and Disulfiram Toxic Interaction*, April 11, 1978; No. 24, *Direct Blue 6, Direct Black 38, and Direct Brown 95 Benzidine Derived Dyes*, April 17, 1978 (Washington, D.C.: U.S. Government Printing Office).

and the Occupational Safety and Health Act complement TSCA authority. In all, at least 20 regulatory statutes apply to toxic substances control. They are administered by six major agencies, with responsibility divided among various programs within agencies.

Even at best, implementing these laws is almost impossibly difficult, considering the vast number of chemical substances in commerce, the diversity of the chemical industry, and the complexity of both the issues and the procedures to deal with them. Recognizing the immensity of the task, the Carter Administration has authorized an increase of the EPA staff responsible for implementing and enforcing TSCA, from about 50 shortly before the Act was passed to almost 600. Nevertheless, it will not be possible to address all the chemicals in commerce at one time. Selections will have to be made and priorities established.

Despite the difficulties, there are many encouraging aspects to the situation. First, most chemicals are not known to be harmful to health or the environment in the concentrations at which they usually appear. Second, we do have the technical know-how to develop many of the data that we need and to build a capability for storage, analysis, and retrieval of information for sound decisions. And the application of a little ingenuity is begining to produce solutions to some problems which had seemed intractable. Thus the past year has seen encouraging developments, such as the following:

- In the 60-odd lead poisoning screening programs in the United States, the percentage of children found with unhealthy lead absorption showed a decrease, from 8.6 per 100 in 1976 to 7.4 in 1977.[13] It also appears that children threatened by lead poisoning are being identified earlier, before lead absorption reaches high levels. Despite the improvement, the effort to identify and reduce lead hazards is still below national goals.[14]
- Decreases in PCB levels in Lake Michigan coho salmon were reported for the first time since monitoring began 5 years ago. The Michigan Department of Natural Resources credits the voluntary restrictions of PCB sales since 1971 by Monsanto, Inc., for the reduction of PCB levels in the state's waters.[15]
- Researchers from the Massachusetts Institute of Technology have developed a technique for transforming PCBs in water. Electron bombardment (at a level that is easily accomplished) splits the water molecule and creates very active fragments, including the hydroxyl radical, which attach themselves to trace organics such as PCBs. The new components are expected to be soluble in water rather than fat and therefore not bioaccumulative. The findings raise hopes that the method can be used to render usable vast quantities of water contaminated by PCBs, DDT, and other trace organics.[16]
- Experimental drug therapy for workers poisoned by the pesticide Kepone may be able to remove other contaminants, such as PCBs, Mirex, and dieldrin from the human body. Preliminary

experiments to determine cholestryamine's effect on chemical transport patterns in animals and people are promising; much more research, however, is needed before results are concrete.[17]

- Tests have demonstrated that a modern sewage sludge incinerator, when modified and fitted with the appropriate air pollution control devices, produced an efficiency of Kepone destruction in excess of 99.9999 percent. Results also indicated that no individual was exposed to detectable levels of Kepone during the incineration and that there was no detectable escape of Kepone into the ambient air.[18] Some 9 million pounds of materials containing this highly persistent, toxic chemical have been stored in Virginia, pending development of a suitable disposal method.[19]
- A natural insect virus product has been approved to combat the gypsy moth, which each year damages or kills thousands of acres of trees in the northeastern United States. The virus occurs naturally in a small number of the insects, but after 15 years of USDA-supported research, scientists have learned how to mass produce and release it in infested areas to create a deadly epidemic among the moths. The virus is expected to affect only this pest, with no effect on people, wildlife, other insects, soil, and water. The first viral pesticide was registered with EPA in 1974 to control cotton bollworms, followed in 1976 by a virus product for the Douglas fir tussock moth, a major pest of evergreens in the northwestern United States.[20]
- Several of the chemical hazards that have made headlines in recent years because of new discoveries about their toxicity, persistence, or sources of exposure are coming under regulatory control, and efforts are being made to coordinate the actions of agencies with different jurisdictions so that important sources of exposure do not go unattended. Asbestos, for example, which has a myriad of uses and is found in products ranging from talcum powder to roofing materials, is the subject of concerted regulatory actions by the Food and Drug Administration, the Consumer Product Safety Commission, EPA, and OSHA directed at food, consumer, environmental, and occupational exposures. The status of regulatory actions for other widespread and recently publicized hazards is summarized in Table 4–2.

Heightened awareness of toxic chemical problems is reflected in recent legislation and administrative programs. The Clean Air Act Amendments of 1977 require EPA to consider regulations for several specific pollutants suspected or known to be toxic.[21] Likewise, the 1977 amendments to the Federal Water Pollution Control Act require best available technology by 1984 for 65 named classes of toxic chemicals and provide for cleanup action against other potentially toxic chemicals by 1987.[22] (Toxic substances in water are discussed further in Chapter 2, Water.)

Strong emphasis on toxics and human health concerns was written into the Resource Conservation and Recovery Act of 1976,[23] which provides for systematic government control over hazardous solid

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wastes from generation to disposal. RCRA also requires sound management practices and encourages prevention of problems through recovery and recycling. The urgency of the toxics problem was recognized in the fiscal year 1978 budget which provides EPA nearly $29 million to implement the Toxic Substances Control Act —a threefold increase over 1977. The President's fiscal year 1979 budget request would double this figure and add significantly to related programs at the National Cancer Institute, OSHA, and other agencies concerned with toxics.

Gypsy moth caterpillars denuded this Trenton, New Jersey, forest, left. Right, an adult male gypsy moth is held captive in a study of synthetic female attractants for possible use as an alternative to insecticides.

COORDINATION

In his 1977 Environmental Message, President Carter gave high priority to prevention of toxic substances problems. He instructed CEQ to develop a coordinated interagency program "(1) to eliminate overlaps and fill gaps in the collection of data on toxic chemicals, and (2) to coordinate federal research and regulatory activities affecting them." Responding to the President's directive, CEQ formed the 17-agency Toxic Substances Strategy Committee comprised of members from federal agencies with major responsibilities for toxic chemicals.[24] The Committee's work concerns not only the Toxic Substances Control Act but also other laws relating to toxic chemicals control, from early development through ultimate disposal, as shown in Table 4–3.

Table 4-2

Regulatory Actions against Selected Chemical Hazards

Chemical	Hazard	EPA	CPSC	FDA	OSHA	Other agencies, states, and courts
Acrylonitrile	Systemic toxin, primarily cumulative; cancer; teratogen (causes birth defects); mutagen (causes mutations); tumorigen (causes tumors); toxic effects of leaded polymer	Assessing risk to set new performance standards for air emissions[1]	Researching extent and nature of hazard in consumer products [2]	Determination that use in beverage containers has not been shown to be safe; ban effective 12/22/77[3]	Emergency Temporary Standard limits employee exposure to 2 parts per million average in air, effective 1/17/78; hearings in progress for permanent standard [6]	
Arsenic	Systemic toxin; lung cancer; skin diseases	Investigating health effects to exposure to arsenic in air,[5] reviewing uses in fungicides, insecticides, and herbicides[6]	Researching extent and nature of chemical hazard in consumer products[7]	Seeking pertinent data; certain compounds of arsenic are used in animal drugs[6]	Current standards for organic arsenic; new standard for exposure to inorganic arsenic effective 8/78[8]; coordination with EPA on pesticides[6]	To be added to list of substances subject to special regulation under California's occupational cancer control program[9]

Asbestos	Cancer; asbestosis; pulmonary fibrosis	Assessing sources and uses of asbestos, including asbestos in fireproofing and home insulation; planning new regulations under Clean Air Act for asbestos in existing buildings[8]	Ban on consumer patching compounds and artificial fireplace ashes containing respirable freeform asbestos[10]; identification and evaluation of other consumer products with asbestos[8]	Researching method to identify absestos in food and hazards of ingestion[8]	Current standard 2 fibers per cubic centimeter of air; hearing to be scheduled; issues include permissible exposure limit, feasibility and cost, separate construction standard[8]; $1.84 million Ohio settlement from manufacturers to construction workers who handle products[11]	Maryland state and county agencies taking measures to control emissions from roads surfaced with crushed stone containing asbestos[12]; Department of Transportation proposal to regulate shipping procedures[13]
Benzene	Leukemia; aplastic anemia; other blood disorders; chromosomal aberrations	Listed as hazardous air pollutant;[14] analyzing population health effects to assess risks and determine control options[15]	Draft ban at levels above 0.1 percent in consumer products such as paint removers[16]	Seeking pertinent data; permitted uses exclude contact with food	Permanent standard limits employee exposure to 1 part per million average in air, effective 3/13/78[17]; special EPA/OSHA task force on benzene in gasoline[8]	Temporary stay of OSHA standard granted 3/13/78 in response to petition from American Petroleum Institute[18]

Table 4-2 (continued)

Chemical	Hazard	EPA	CPSC	FDA	OSHA	Other agencies, states, and courts
Cadmium	Systemic toxic; cancer	Studying need to regulate air sources based on health impacts, carcinogenic risk sources, and environmental impacts of control options[6]; fungicide use under review[19]	Studying need to limit use in ceramic pigments in decorative frits in glassware[6]	Investigating chronic effects, levels in food supply, entry into food supply through use of sludge (with EPA, USDA), levels in shellfish[6]	Current standard of 0.1 milligram per cubic meter (fume) and 0.2 milligram per cubic meter (dust),[6] primarily in plastics, pigments, and metal alloy industry NIOSH recommended standard of 40 micrograms per cubic meter (dust and fume combined) under review[20]	
Chlorinated solvents: trichloroethylene (TCE), perchloroethylene (PCE), methyl chloroform (CH_3Cl_3), chloroform ($CHCl_3$), methyl chloride (CH_2Cl_2)	Central nervous system disorders; liver dysfunction; possible carcinogens	Plans for regulating $CHCl_3$ in drinking water; considering regulations for PCE under Clean Air Act[6]	Researching the extent and nature of hazard in consumer products; drafted proposal for warnings on CH_2Cl_2 containing paint strippers for people with heart and lung problems[6]	Draft final rule revoking use of TCE; PCE permitted in adhesives not in contact with food[6]; $CHCl_3$ regulated (6/76) in human drugs and cosmetics[21]; analyzing indirect food additive uses	Studying PCE mortality[22]; proposal for occupational exposure to TCE published August 1975; developing proposals for PCE and CH_3Cl_3[6]	

Chromates	Irritation and ulceration of skin; perforation of nasal septum; cancer	Revising 1976 drinking water and water quality standards. Listed as hazardous substance under FWPCA § 311[6]		Seeking pertinent data; permitted as colorant in rubber products contacting food[6]	Current ceiling exposure of 100 micrograms per cubic meter (as CrO_3); proposed standard under development[23]	
Coke oven emissions	Lung disease; cancer	Determining whether to list as "new source" or "hazardous" pollutant under Clean Air Act; Water Programs assessing need to propose effluent guidelines[6]			Final standard limits emissions to 0.15 milligram per cubic meter where coke is produced from coal, issued 10/76[24]	American Iron and Steel suit against OSHA claiming that meeting standard is technologically and economically infeasible[25]
Dibromopropane (DBCP)	Sterility; cancer	Pesticide use under review (primarily used as soil fumigant, nematocide)[26]		Monitoring food for DBCP residues; enforcement guidelines prepared[6]	Final standard for occupational exposure to 1 part per billion and prohibits eye and skin contact, issued 3/78[27]	
Ethylene dibromide (EDB)	Cancer	Environmental Defense Fund petition (8/77) to regulate; pesticide and other uses under review[28]		Seeking pertinent data; tolerance established for use as grain fungicide[6]	NIOSH recommendations received 8/77; request for comments and information published in 43 Fed. Reg. 11227[23]	

Table 4-2 (continued)

Chemical	Hazard	EPA	CPSC	FDA	OSHA	Other agencies, states, and courts
Ethylene oxide	Local toxicity, burns; mutagen	Use as insecticidal, fungicidal, and bactericidal fumigant on copra, black walnuts, and spices, under review[29]		Permits use as sterilant and disinfectant; working on action levels for residues in surgical instruments[30]	Current standard 50 parts per million; NIOSH special review evaluating hazards of use in medical facilities[31]	
Lead	Lead intoxication and poisoning; subclinical effects	Ambient air standards, revised national primary drinking water regulations, criteria for lead in ambient waters, industrial effluent guidelines, levels in solid wastes, and environmental and economic impact analysis in progress[6]	Ban on paints containing an excess of 0.06 percent; proposed amendment to exempt some painted metal furniture from ban[32]	Proposed tolerance in evaporated milk published 12/74; new proposal on temporary action level to be completed[6]	Current standard 0.2 milligram per cubic meter; preparing final regulation, incorporating special issues of susceptible groups and medical removal protection[6]	
PBBs	Environmental contamination; human toxicity	Investigating the need to regulate the manufacture and use of PBBs as flame retardant[33]		Petitioned to establish tolerance control denied 8/12/77	Subject to compliance inspections; no permanent standard[6]	

PCBs	Environmental contamination and persistence; damage to wildlife and fisheries; possible carcinogen; human toxicity	Final rule prescribing disposal and marking requirements for PCBs effective 4/18/78[34]; ban on production (as mandated by TSCA) proposed 6/7/78[6]		Proposal to lower allowable PCBs in fish, shellfish, dairy products, and poultry 4/1/77; final expected following analysis of comments[35]	Subject of compliance inspections; regulated as chlorobiphenyl; occupational exposure of 1 microgram per cubic meter recommended by NIOSH[36]	Products containing PCBs need Minnesota state pollution control agency approval before use[37]
Sulfur dioxide	Respiratory irritant; environmental damage	EPA criteria air pollutant, criteria revision scheduled 5/80[6]		Generally regarded as safe for consumer products; status currently under review[6]	Current standard 5 parts per million; reviewing proposal (11/75) to reduce some occupational exposure to 2 parts per million[38]; 0.5 part per million recommended by NIOSH[39]	
Vinyl chloride (VC), polyvinyl chloride (PVC)	System toxicity; cancer	VC hazardous air pollutant amendment proposed 6/2/77 to reduce emissions to zero[6]	Ban on VC in aerosol cans under Federal Hazardous Substances Act, effective 6/22/78[40]	Proposal published 9/3/75[6]	Exposure limit of 1 part per million in workplace[41]	California now requiring report on employees using or manufacturing VC, under state occupational cancer control program[42]

Table 4-2 (continued)

[1] *Chemical Regulation Reporter (CRR)* 1:956 (1977).
[2] *Id.* at 828.
[3] 42 Fed. Reg. 48528 (1977).
[4] 43 Fed. Reg. 2586 (1978).
[5] 42 Fed. Reg. 56786 (1977).
[6] *CRR* 1:1916–21, IRLG chart.
[7] *CRR* 1:700.
[8] 43 Fed. Reg. 19584 (1978).
[9] *Occupational Safety and Health Reporter (OSHR)* 7:1528 (1978).
[10] 42 Fed. Reg. 63354 (1977).
[11] *CRR* 1:1646.
[12] 42 Fed. Reg. 58543 (1977).
[13] 43 Fed. Reg. 8562 (1978).
[14] 42 Fed. Reg. 29332 (1977).
[15] *CRR* 1:1297.
[16] *CRR* 2:11 (1978).
[17] 43 Fed. Reg. 5918 (1978).
[18] *CRR* 1:1955.
[19] 42 Fed. Reg. 56574 (1977).
[20] *Id.* at 5437.
[21] 41 Fed. Reg. 26842 (1976).
[22] *CRR* 1:1243.
[23] Updated information on IRLG chart, *supra* note 6, provided by Bob Cluck, OSHA.
[24] 41 Fed. Reg. 42741 (1976).
[25] *OSHR* 7:1237 (1978).
[26] 42 Fed. Reg. 48026 (1977).
[27] 43 Fed. Reg. 11514 (1978).
[28] 42 Fed Reg. 63134 (1977).
[29] 43 Fed. Reg. 3800 (1978).
[30] *Id.* at 3801.
[31] *OSHR* 7:500 (1977).
[32] 43 Fed. Reg. 1804 (1978).
[33] 42 Fed. Reg. 55134 (1977).
[34] 43 Fed. Reg. 7150 (1978).
[35] 42 Fed. Reg. 17487 (1977).
[36] *CRR* 1:1030.
[37] *Id.* at 1648.
[38] *OSHR* 6:1387 (1977).
[39] *Id.* at 1543.
[40] 43 Fed. Reg. 12308 (1978).
[41] 24 C.F.R. 1910.1017(c).
[42] *OSHR* 7:12 (1977).

The Committee expects to give at least initial attention to all the matters in its work plan within 1 year and to make a status report on actions taken and further actions recommended at the end of 1978.[25] The principal matters to be addressed by the Committee are:

- Regulatory and other approaches to prevention and control of toxic chemicals problems
- The usefulness of federal toxics research in support of regulation and policy
- Policies for handling trade secrets and confidentiality of data
- An analysis of case histories of past federal actions [26]
- Coordinated collection and exchange of data among federal agencies
- Development of a common set of principles for identifying carcinogens for use throughout the federal government

Among the complex tasks that the Strategy Committee must face is the development of a plan of action for handling spills and other emergencies. Examples of such emergencies are uncontrolled exposure of human beings to toxic chemicals from local sources, as in the Kepone and PBB incidents, railroad and other transportation accidents, and spills of toxic chemicals in the course of a natural disaster such as the Johnstown flood. During 1978 a succession of railroad accidents involving toxic chemicals at Waverly, Tennessee,[27] Youngstown, Florida,[28] and Brownson, Nebraska,[29] pointed up the importance of contingency planning. The Committee intends to look into all aspects of chemical emergencies; the range is extremely broad, encompassing financial and legal responsibilities, resource management, public information, and many other matters.

The important roles of local and state governments and industry are being given significant attention. A survey of state capabilities shows considerable variation. The Committee will collect information on methods that work from the few states with excellent systems and provide it as guidance for use by other states. Federal measures to support the state efforts will also be recommended. The part played by state and local authorities is often crucial in emergencies. The critical stage with spills and accidents is usually the first hour or two when the people usually in charge are state police and local fire departments. Both need improved training in recognizing problems and taking action to ensure public health and safety and to minimize further spread and damage.

Another closely related group which coordinates federal interests in toxic substances is the Interagency Regulatory Liaison Group, formed in 1977 by the Food and Drug Administration, the Environmental Protection Agency, the Consumer Product Safety Commission, and the Occupational Safety and Health Administration. The group published an interagency agreement in October 1977 in which it promised a common and consistent or compatible approach to

- Testing protocols, criteria for interpretations, quality assurance

Table 4-3

Federal Laws and Agencies Affecting Toxic Substances Control

Statute	Year enacted	Responsible agency	Sources covered
Toxic Substances Control Act	1976	EPA	Requires premarket evaluation of all new chemicals (other than food additives, drugs, pesticides, alcohol, tobacco); allows EPA to regulate existing chemical hazards not covered by other laws related to toxic substances
Clean Air Act	1970, amended 1977	EPA	Hazardous air pollutants
Federal Water Pollution Control Act	1972, amended 1977	EPA	Toxic water pollutants
Safe Drinking Water Act	1974, amended 1977	EPA	Drinking water contaminants
Federal Insecticide, Fungicide, and Rodenticide Act	1948, amended 1972, 1975	EPA	Pesticides
Act of July 22, 1954 (codified as § 346(a) of the Food, Drug and Cosmetic Act)	1954, amended 1972	EPA	Tolerances for pesticide residues in food
Resource Conservation and Recovery Act	1976	EPA	Hazardous wastes
Marine Protection, Research and Sanctuaries Act	1972	EPA	Ocean dumping
Food, Drug and Cosmetic Act	1938	FDA	Basic coverage of food, drugs, and cosmetics
Food additives amendment	1958	FDA	Food additives
Color additive amendments	1960	FDA	Color additives
New drug amendments	1962	FDA	Drugs
New animal drug amendments	1968	FDA	Animal drugs and feed additives
Medical device amendments	1976	FDA	Medical devices

Wholesome Meat Act	1967	USDA	Food, feed, and color additives and pesticide residues in meat and poultry
Wholesome Poultry Products Act	1968	USDA	
Occupational Safety and Health Act	1970	OSHA	Workplace toxic chemicals
Federal Hazardous Substances Act	1966	CPSC	"Toxic" household products (equivalent to consumer products)
Consumer Product Safety Act	1972	CPSC	Dangerous consumer products
Poison Prevention Packaging Act	1970	CPSC	Packaging of dangerous children's products
Lead Based Paint Poison Prevention Act	1973, amended 1976	CPSC	Use of lead paint in federally assisted housing
Hazardous Materials Transportation Act	1970	DOT (Materials Transportation Bureau)	Transportation of toxic substances generally
Federal Railroad Safety Act	1970	DOT (Federal Railroad Administration)	Railroad safety
Ports and Waterways Safety Act	1972	DOT (Coast Guard)	Shipment of toxic materials by water
Dangerous Cargo Act	1952		

CPSC = Consumer Product Safety Commission
DOT = U.S. Department of Transportation
EPA = U.S. Environmental Protection Agency
FDA = Federal Drug Administration
OSHA = Occupational Safety and Health Administration
USDA = U.S. Department of Agriculture

procedures, and other policies relating to the testing of toxic and hazardous substances
- Epidemiological practices and procedures
- Assessment of risks presented by toxic or hazardous substances and estimation of benefits from chemical substances
- Methods of obtaining, analyzing, storing, and exchanging information which might be of mutual interest
- Research and development policies, possibly including methods of sharing costs and facilities
- Regulations and regulatory development activities when a hazard can be most effectively controlled by joint participation or by use of the statutory authorities of more than one agency, for example, joint public hearings or rulemaking action
- Compliance and enforcement procedures and policies
- Public communication and education programs and informational services to industry
- Other activities as may be applicable.[30]

The task of evaluating data needs and coordinating the data systems of more than 30 federal agencies into one comprehensive program responsive to nonfederal as well as federal users is being done for the Strategy Committee by an independent permanent body, the Interagency Toxic Substances Data Committee.

Cochaired by CEQ and EPA, the Committee has some important tasks related to coordination in addition to systems development—to fulfill EPA's responsibility under TSCA to receive interagency committee advice on meeting the information needs of other agencies when gathering data under TSCA [31] and to fulfill the TSCA requirement that CEQ coordinate with other agencies a study of whether it is feasible to develop standard systems for chemical classification and for storage and retrieval of information.[32]

IMPLEMENTING TSCA

The Toxic Substances Control Act,[33] which became effective January 1, 1977, gives EPA broad authority to review substances before they are manufactured for commercial purposes and to take action to prevent any unreasonable risk of injury to health or the environment. The intent of the Act is that harmful effects of chemicals produced in the future shall be investigated and if possible discovered in the laboratory rather than turning up in injuries to human beings or the environment after full-scale production has begun. TSCA also provides for regulation and control of chemicals already in commerce that pose a danger to human health and/or the environment.

TSCA is a long and complicated piece of legislation which resulted from work in three Congresses. To implement it effectively and meet the high expectations raised by its enactment, EPA must comply with a tight timetable, wrestle with a number of important un-

defined terms, and promulgate regulations that will carry out the intent of the law and will be accepted by both industry and public interest groups.

REQUIREMENTS OF TSCA

Action-forcing deadlines are contained in several sections of the Act, as shown in Table 4–4. However, the structure of the legislation provides EPA with flexibility in its implementation. Because the law encompasses as many as 70,000 chemical substances in commerce, 4 million substances now known or in research and development, and 1,000 new chemicals introduced to the market each year, EPA must set priorities. Substances must be selected for investigation in an orderly fashion and priorities determined for regulatory actions. The TSCA information-generating sections will therefore receive major emphasis in the early years of implementation. Promulgation of regulations for specific chemicals will not be a major component of early implementation efforts because most of these actions will grow out of the information gathering, testing, and priority setting now getting underway.

Nonetheless, labeling and disposal regulations for polychlorinated biphenyls [34] and a prohibition on nonessential uses of chlorofluorocarbons are already complete.[35] The requirement for action on PCBs is laid down by the law. EPA is reviewing for possible regulation several chemical substances for which hazard assessments have been underway for some time.

INFORMATION COLLECTION UNDER TSCA

Recordkeeping and Reporting

At present there is both too much and not enough information on chemical substances. It is not uncommon for a search of the scientific literature to uncover several thousand sources on a single chemical but to reveal little about the relative quality of the myriad pieces of information or the whereabouts of information that is critically needed at a particular moment. Information vital to protecting the public health and welfare may be missing entirely. For example, it was not even known how many chemicals are commercially produced in the United States until EPA collected the information this year under authority of TSCA.[36]

The extensive testing, recordkeeping, and reporting authorities of TSCA provide EPA with the necessary legal tools to develop the information base needed for rational control of chemicals technology. EPA's general strategy will be to identify gaps in the information it already has before issuing testing and reporting requirements, thus avoiding duplication in reporting.[37]

As a first step, the Act requires EPA to develop an inventory of existing chemical substances. The inventory will provide baseline data on chemicals in commerce and permit identification of new

Table 4-4

Actions Required by the Toxic Substances Control Act

Section	Deadline	Action
Section 4 Testing of chemical substances and mixtures 4(e)(2)(B)(iii)	3/2/77	Initial appointments to Interagency Testing Committee.
	90 days after initial appointments	Committee shall meet for selection of chairperson.
4(e)(1)(B)	10/1/77	Committee shall list and designate 50 chemical substances to which EPA Administrator should give priority consideration for regulation.
	Every subsequent 6 months	Committee shall revise list.
	Within 12 months of receiving initial list	Administrator shall either initiate rulemaking for each substance on the list or explain reasons for not initiating action.
4(f)(2)	1/1/79	After this date, Administrator shall, within 180 days of receiving information that a substance might present a significant risk, initiate action to reduce the risk or publish a finding that the risk is not unreasonable.
4(b)(2)(B)	Every 12 months	Administrator shall review adequacy of standards for developing test data and make appropriate revisions where necessary.
4(d)	15 days after receiving test data	Administrator shall publish notice of receipt and nature of data in *Federal Register*.
4(g)	60 days after receiving petition for testing standards	Administrator shall grant or deny petition and publish reasons for denial.
	75 days after granting testing standards petition	Administrator shall prescribe standards.
Section 8 Reporting and retention of information 8(a)(1)	7/11/77	Administrator shall promulgate requirements for manufacturer recordkeeping for purposes of the 8(b) inventory.

8(b)(1)	11/11/77	Administrator shall publish initial inventory list of all U.S.-manufactured chemicals.
Section 5 **Manufacturing and processing notices**		
5(a)(1)(A)	30 days after publication of list of all U.S.-manufactured chemicals (8)(b)	Persons shall notify Administrator 90 days in advance of manufacturing a new chemical substance or an old chemical substance for a significant new use.
5(c)(2)	5 days after receipt of premarket notification	Administrator shall publish notice of premarket notification in *Federal Register*.
5(c)(3)	At beginning of every month	Administrator shall publish list of each chemical substance for which notice has been received and for which notice has not expired within the previous month.
5(e)(1)	Not later than 45 days before manufacture is scheduled to begin	Administrator may issue proposed order, to take effect on expiration of the 90-day premarket notification period, to prohibit, limit, or in any way regulate manufacture.
5(e)(1)(C)	Within 30 days of proposed order	Manufacturer may file specific objections to the order.
5(g)	Before expiration of the 90-day period	If no action is taken to regulate a substance, Administrator must explain why.
5(h)(6)	Immediately upon receipt of application for exemption from premarket notice or testing requirements	Administrator shall publish notice of receipt in *Federal Register*.
	45 days after receipt of an application for exemption	Administrator shall grant or deny application.
Section 6 **Regulation of hazardous chemical substances and mixtures**		
6(d)(2)(B)	5 days after receipt of request for hearing on any regulation effective upon publication	Administrator shall begin hearings.
6(e)(1)	7/1/77	Administrator shall prescribe methods for disposal of polychlorinated biphenyls and shall prescribe labeling standards for them.
6(e)(2)(A)	1/1/78	Persons are prohibited from manufacturing, processing, or distributing PCBs in any but an enclosed manner.

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Table 4-4 (continued)

Section	Deadline	Action
6(e)(2)(B)	1/1/78	Administrator may grant exemptions if no unreasonable risk is posed.
6(e)(3)(A)(i)	1/1/78	Persons are prohibited from manufacturing, processing, or distributing PCBs except in case of administrative exemption.
Section 21 Citizens' petitions 21(b)(3)	90 days after receipt of citizens' petition asking for issuance, revision, or repeal of certain regulatory orders	Administrator shall deny or grant petition.
21(b)(4)	60 days after administrative denial of petition	Citizen shall commence civil action if he/she intends to do so.
Sections 25–30 Studies and reports 26(e)(2)(A)	4/1/77	EPA Administrator and HEW Secretary shall define term "known financial interest" and establish filing methods.
25(b)	7/1/77	CEQ shall submit report to Congress on the feasibility of establishing standards for classification and storage of data.
30	1/1/78 and every subsequent 1/1	Administrator shall submit annual report to President and Congress on the administration of TSCA.
26(e)(1)	2/1/78 and every subsequent 2/1	All officers of EPA and HEW shall submit written financial statements to EPA Administrator or HEW Secretary.
26(e)(2)(B)	6/1/78 and every subsequent 6/1	EPA Administrator and HEW Secretary shall report progress to Congress.
25(a)	1/1/79	Administrator shall submit report to Congress on feasibility of indemnification for persons affected by EPA actions.
	7/1/79	General Accounting Office shall report its review of indemnification study to Congress.
28(c)	6 months after end of fiscal years 1979, 1980, and 1981	Administrator shall submit report to Congress summarizing state programs operated by grants awarded that year under TSCA.

Source: Adapted from *Toxic Materials News*, December 22, 1976, pp. 207–208.

chemical substances so that industry can meet the Act's requirements for notifying EPA before manufacture of a new chemical begins. EPA's original proposal for inventory reporting required that only the identities of manufactured substances be reported.[38] Environmental groups urged the agency to include reporting of site information, production volumes, and chemical uses; industry argued for requiring only chemical identities, as originally proposed.

Regulations as reproposed in August 1977 [39] and made final in December 1977 [40] require manufacturers and importers—and at a later date, processors—to report to EPA concerning the identity of each chemical substance manufactured at each site or imported for a commercial purpose, the estimated amount of each chemical substance manufactured at each site or imported, and an indication of whether each chemical substance is manufactured and used only within one site. The rules are designed to minimize duplication of effort in future reporting requirements, to lay the basis for selection of chemicals for more detailed reporting, considering their potential for human and environmental exposure, and to fulfill other purposes, such as helping regional officers track down the source of a spill.

EPA has received some 120,000 reports covering up to 70,000 substances and plans to publish the inventory in January 1979. The next round of information that EPA will seek will focus on a portion of these chemicals and will include data on use and perhaps other factors such as byproducts and how long a chemical has been in production. A revised inventory, to be published in 1979, will include information from chemical processors and will include new substances that have come on the market.[41] Meanwhile, EPA is exploring ways to score uses in relation to potential exposure. Results of this effort may contribute to a better definition of chemical categories for reporting so that substances produced in substantial quantities and destined for high exposure uses can be distinguished from those of generally lesser importance.[42]

EPA is also collecting information under the section of TSCA which requires any manufacturer, processor, or distributor of chemicals to report any information not otherwise known to EPA indicating that the substances present a substantial risk of injury to health or the environment.[43] As originally proposed, any employee with such knowledge would have been required to report. Industry objected that the rule should apply only to those with relevant expertise and corporate responsibilities. EPA's interpretation and enforcement policy concerning this section, published in March 1978,[44] makes the president, principal officers with relevant responsibilities, and other officers and employees capable of appreciating the significance of pertinent information subject to the reporting requirements. EPA's policy also generally describes the kinds of information that may support a conclusion of substantial risk, what need not be reported, and other issues. Approximately 200 "substantial risk" notices had been received by mid-1978. Most of them con-

cern occupational hazards and are being referred to NIOSH and OSHA for further investigation and action.

Premanufacture Notification

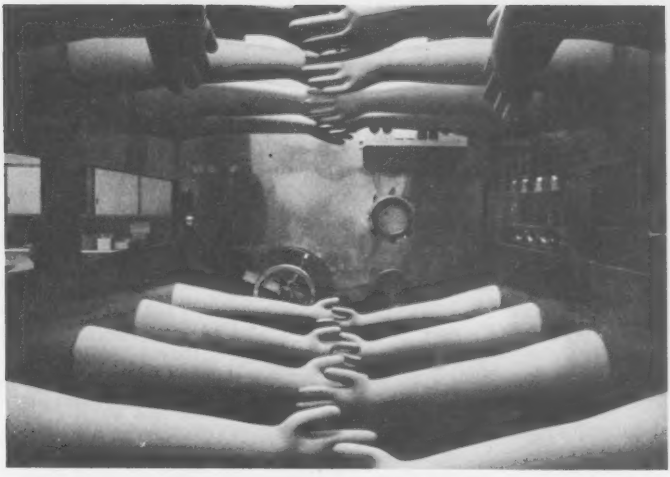
The law also requires that EPA be given at least 90 days' advance notice before the manufacture of any new chemical substance or processing of any substance for a significant new use is to begin. The term "new" applies both to substances that are not contained in EPA's inventory and to significant new uses of existing substances. For premanufacture notification, as for testing, regulatory action, and many other provisions of TSCA, selection is imperative. The mass of chemical substances coming on the market is simply too great to require premarket notification for all of them. As with testing, EPA will attempt to concentrate on the substances that carry the greatest potential risk. EPA is considering development of guidelines that will indicate what information is needed to evaluate the risks of various classes of chemical substances before they are placed on the market. These guidelines will be supplemented by testing rules which will apply to certain categories of substances and effects; issuance of such regulations is a task of high priority.[45]

Testing

Although the reporting authorities in TSCA may provide the government with a wealth of information about the chemical industry never before available, this information base is nevertheless inadequate for building a rational regulatory strategy because so few chemicals have been studied and characterized as to their environmental persistence and transport or long-term biological effects. TSCA authorizes EPA to require manufacturers to test their chemicals for these and other characteristics. Obviously, not all 70,000 chemicals in commerce can be adequately tested at once, and EPA is developing a priority scheme for selecting chemicals for testing.

To advise EPA in its selection process, TSCA established the Interagency Testing Committee to recommend to EPA chemical substances which should receive priority for testing to determine their hazard to human health or the environment.

To ensure that the interests and expertise of agencies with differing missions are taken into account, the law requires the ITC to have eight members—from EPA, the Occupational Safety and Health Administration, the National Cancer Institute, the National Institute for Environmental Health Sciences, the National Science Foundation, the National Institute for Occupational Safety and Health, the Department of Commerce, and the Council on Environmental Quality. At the invitation of the Committee, the Consumer Product Safety Commission, the Department of Defense, the Food and Drug Administration, and the Department of the Interior, which also have programs related to the control of toxic substances, contribute liaison representatives.



Workers at DOE's Sandia Laboratories at Livermore, California, handle hazardous materials by reaching into sealed "gloveboxes."

A review of the Committee's first selections for testing illuminates the challenge of setting priorities. In its initial report,[46] the Committee lacked even the baseline data being collected for the January 1979 inventory and faced a number of other difficult problems. How is it possible to select which chemicals are most important to test when even the identities and number of chemicals in production are unknown? Once an inventory or partial inventory is in hand, what criteria should be used to choose among chemicals listed for early testing—those that are most persistent in the environment? Most toxic? Produced in the greatest quantities? Should the focus be on filling the gaps for chemicals that we already know something about or on developing data on those about which we are most ignorant? TSCA offers some guidance by enumerating some of the factors to be taken into account, such as production volume, environmental release, occupational exposure, and various types of effects.

The Interagency Testing Committee considered several alternative approaches, such as using extant chemical lists compiled by agencies for various purposes to nominate specific substances for consideration, using structure-activity relationships to focus on substances chemically similar to others of known hazard, or concentrating on substances known to have high levels of exposure. Early in its deliberations, the Committee rejected any shortcuts and elected to grapple directly with the challenge of developing a logical selection strategy employing features of all the alternatives.

The Committee elected to limit its initial consideration to substances already suspect from previous reviews of potentially adverse health or environmental effects or substances produced in large volume or released widely to the environment. A first listing of

some 3,650 substances and categories was compiled from 19 data sources (for example, a list developed for the National Science Foundation of chemicals having the greatest potential for environmental release, a Department of the Interior list of 144 substances suspected of being hazardous to fish and wildlife, a list of 160 chemicals of environmental concern compiled by the Canadian government).[47] After eliminating substances that are not in commercial production or ones that are not covered by TSCA, the Committee began to score and rank the substances in terms of annual production volume, environmental release, occupational exposure, and general population exposure. Information on the use of a substance was critical to the assignment of scores—but unfortunately was unavailable for more than one-half the substances. They were deferred for consideration later. Also deferred for consideration later were substances which were already under stringent regulation or were judged to be well characterized, essentially inert materials, substances covered by testing requirements under other legislation, and certain natural products. The resulting list of 330 substances was published for public review.[48] Comments were received from about 65 industrial firms, trade associations, environmental groups, government agencies, and individuals.

The remaining chemicals were then scored and ranked for similarity in chemical structure to substances of known hazard, the existence or absence of data on effects, and the extent to which testing might result in data useful for predicting health or environmental effects. After reviewing each of the ranked lists, the Committee slated 80 substances for detailed review. After taking into account test programs already in progress, the current status of regulatory action for individual substances, and the need for test data on all members of a class of chemicals, for its first report in October 1977,[49] the committee selected four individual substances and six categories, listed in Table 4–5. Eight more substances and categories were added in April 1978.[50] As required by statute, the Committee will continue its review process, reporting to the EPA Administrator every 6 months.

By law EPA must begin rulemaking to require testing for these substances by October 1978 or publish in the *Federal Register* an explanation as to why such action has not been taken.[51] In meeting its data-gathering, testing, and regulatory responsibilities, EPA will also have to develop its own priorities for selecting chemicals for testing. In doing so, it will have to grapple with many of the same problems and issues that the Committee faced and may select more, fewer, or different chemicals for testing or even develop a different set of principles for selecting them. Many factors will influence these decisions. For example, in the near future the agency will have the benefit of a complete inventory of existing chemicals, including production volumes—information unavailable to the Committee for its first reports. Of course, this information is a two-edged sword; it is a more complete list of chemicals to worry about,

but it is also a formidable file of up to 70,000 chemicals to sift through, many more than the 3,600 that the Committee dealt with for its first selections.

Other factors that might affect EPA's response to the Committee's recommendations—as well as the Committee's own decisions in the future—could include new scientific developments. Examples are improved methods for predicting biological behavior solely on the basis of molecular structure or chemical properties or discovery of a new kind of hazard, such as the potential for stratospheric ozone reduction by chlorofluorocarbons which first came to light in 1974. Because testing is costly—$300,000 or more is typically required for a complete animal test for carcinogenesis [52]—and because identifying the hazardous properties of a chemical is a step toward putting it on a list of candidates for regulation, the next few years are likely to see a lively debate about how those chemicals are to be selected.

EPA must also prescribe standards for conducting tests on the chemicals selected. The first testing standards developed under the law will be directed toward determining whether chemical substances are oncogens (tumor-causing substances). Although the first proposal will be for a 2-year animal feeding study, EPA plans eventually to take a tier approach, that is, narrower, more definitive tests will follow broader simpler screening tests. The results of selected cell culture screening tests, for example, will provide bases for selecting substances for longer, more expensive whole animal tests for carcinogenicity.

EPA has testing standards under development for chemical fate and ecological effects. Like the standard for oncogenic effects, these standards will probably entail a tiered series of tests. Testing requirements for reproductive effects are also being developed.

Data Management

The development of rational priorities for testing and regulation is obviously hampered by great gaps in the existing information base. Inventory reporting, premanufacture reporting, and other data now being gathered under TSCA requirements should be of considerable value in future efforts of this kind. But as a more extensive data base is collected, a different kind of data problem emerges—organization and management.

Increasing knowledge about pervasive suspects is creating an unprecedented need for improved data and information systems. There are over 220 federal data systems containing data relevant to toxic substances assessment. Many of them are designed to meet only the particular needs of the parent agency and contain data that are duplicative, very highly specialized, or difficult to get for other purposes.

TSCA explicitly recognizes the importance of improving data management with its requirement that CEQ coordinate a feasibility study on a standard classification system for chemicals and a standard means of storing and retrieving information about them.

Table 4-5

Substances and Categories of Substances Initially Recommended for Testing by the Interagency Testing Committee

Substance or category	Use	Amount and route of exposure	Effects of concern	Recommended testing
Alkyl epoxides	Intermediates in the manufacture of industrial chemicals; in medical facilities for sterilization of heat-sensitive materials	Occupational exposure to more than 530,000 workers; in consumer products such as paint strippers and detergents; over 140 million pounds released annually to environment	Some show potential mutagenic and carcinogenic activity; their reactivity, large scale of production, and uncertainty of environmental transport make further testing desirable.	Carcinogenicity; mutagenicity; teratogenicity; other chronic effects; environmental effects; epidemiological study
Alkyl phthalates (if 10 million pounds or more produced per year)	Plasticizers in various products, including vinyl chloride, resins; household applications such as model cements, paints, and wood finishes	Occupational exposure to approximately 3 million persons; produced in large volumes, with about 500 million pounds released annually to the environment (primarily aquatic)	Some have shown considerable toxicity to freshwater fish; because of large volume of environmental release, the persistence and accumulation in aquatic organisms and resultant toxicity make further testing desirable.	Environmental effects
Chlorinated benzenes, mono- and di-	Solvent applications, industrial processes, and many consumer products	Occupational exposure to more than 1 million workers; approximately 100 million pounds released annually to environment	High release rate led to potential for bioaccumulation and to human exposure hazard; liver, kidney, respiratory, and neurological effects have been observed following exposure; possible relationship with leukemia; more data needed.	Carcinogenicity; mutagenicity; teratogenicity; other chronic effects; environmental effects; epidemiological study
Chlorinated paraffins	In wide variety of household and paint products, adhesives, and flame retardants	Occupational exposure to approximately 1.75 million workers; more than 50 million pounds released annually to environment	A chronic study in mice showed evidence of degenerative changes in the liver and spleen; no other health effects data available; bioaccumulation found in fish; further environmental testing needed.	Carcinogenicity; mutagenicity; teratogenicity; other chronic effects; environmental effects

Chloromethane	Primarily an industrial intermediate	Occupational exposure to approximately 31,000 workers; more than 18 million pounds released to environment; large release to atmosphere from combustion of PVC-containing waste	Exposure to chloromethane has been implicated in damage to the central nervous system, liver, kidney, and lungs; also shown to exhibit mutagenic properties; more data needed to determine human health hazards.	Carcinogenicity; mutagenicity; teratogenicity; other chronic effects
Cresols	Industrial solvents; in disinfectants, metal cleaners, motor oil additives, and other consumer products	Occupational exposure to approximately 2 million workers; approximately 46 million pounds released to environment	Have a broad spectrum of toxicity to microorganisms, are moderately toxic to mammals by ingestion and dermal exposure, and are corrosive to skin and other tissues; few data available on human health effects.	Carcinogenicity; mutagenicity; teratogenicity; other chronic effects; environmental effects
Hexachloro-1,3-butadiene	Industrial solvent (imported, not U.S.-manufactured)	Waste product of various chlorination processes; good evidence of widespread distribution in aquatic environment	Human health effects being studied in depth; wide distribution and potential for bioaccumulation in aquatic systems causes concern and need for studies.	Environmental effects
Nitrobenzene	Primarily in aniline manufacture (closed use); industrial solvent and dye intermediate; various household uses (polishes)	General population exposure from household uses; approximately 20 million pounds released annually to environment	Mammalian toxicity effects have been studied; biological activity indicates need to study other health effects; additional data also needed to characterize persistence in aquatic environment and effects on species.	Carcinogenicity; mutagenicity; environmental effects
Toluene	Solvent, gasoline additive, and many industrial and household uses (increasing substitute for benzene)	Occupational exposure to more than 4 million workers; exposure from consumer products; annual release rate exceeds 1 billion pounds	Liver, central nervous system, and hematopoietic effects resulted from high level exposure; other human health data limited and inconclusive; large potential exposure causes concern and need for further tests.	Carcinogenicity; mutagenicity; other chronic effects; epidemiological study
Xylenes	In several industrial chemical production processes and as solvent (substitute for benzene)	Occupational exposure to more than 4 million workers; general population exposure from consumer products; approximately 900 million pounds released annually to environment	Tests show toxic effects to several organ systems and that xylenes can cross the placental barrier; more data needed on human health effects.	Mutagenicity; teratogenicity; epidemiology

Source: TSCA Interagency Testing Committee, *Initial Report of the TSCA Interagency Testing Committee to the Administrator, Environmental Protection Agency* (Washington, D.C.: U.S. Government Printing Office, 1977), Information Dossiers.

CEQ, EPA, and the Department of Health, Education, and Welfare began a jointly sponsored study in March 1976 and published a report that outlined data needs and the basic elements of a Chemical Substance Information Network for meeting those needs in June 1977.[53] As a first step, potential users of chemical substance information—EPA, other federal agencies, industry, and educational and public interest groups—were surveyed and their information needs characterized.

One of the study's findings was that requirements for an integrated system vary in size and detail. For example, extensive detailed information may be needed by EPA for regulating 50,000–100,000 commercially produced chemicals. But identification of substances and information on the structure of chemicals may be needed by various agencies involved in research or regulation of up to 500,000 chemicals.

Existing systems could supply some of the material requested by users. Some new systems are needed, and nearly all need to be made more useful. The report proposed the creation of a loosely coupled network of data bases composed of a set of directly linked core component data bases and a set of noncore files, which are referenced by the core system.

One core component of the network will contain data gathered under authority of TSCA. The public will have access to most information in this system; health and safety data will almost always be subject to disclosure. EPA will protect confidential data, such as trade secrets and privileged financial data, from disclosure [54] and has reviewed and revised its internal security procedures in this area.[55] Other proposed core components may include:

- Chemical Data Bases Directory—a file to provide detailed information on the nature of all systems in the network and direct the user to the systems that will meet particular needs
- Chemical Structure/Nomenclature System—provides chemical identification data for approximately 500,000 chemicals and a pointer to other files containing information on particular chemical substances
- Toxicology Data System—a source for research data from government, industry, academic institutions, and others on biological effects of chemicals
- Chemical Testing Support System—a storage and retrieval system for collecting, monitoring, evaluating, and reporting the raw data from testing studies
- Bibliographic Literature Scanning System—a reference system for toxicological and biomedical journals
- Laboratory Animal Data System—provides toxicological information on laboratory animal strains for use in designing test systems
- Regulated Chemicals Standards System—provides user with information on standards or regulations affecting chemicals or classes of chemicals.

Development of a network will require a level of cooperation and coordination among agencies that is virtually unprecedented. A key element is adoption of a common system in identifying chemical structures.

Most unique chemical substances can be described unambiguously by a structural diagram. However, in most files that contain chemical information, it is not possible to carry structure diagrams for compound identification purposes. Instead, these files generally identify chemical substances by the use of names. The names vary in accuracy and information content from exact chemical nomenclature, which can be a true representation of the structure, to generic names, trivial names, codes, or numbers which have little or no information content. The fact that the same substance can be identified quite differently in various files leads to ambiguities and mistakes in attempts to transfer (or link) information concerning chemicals from one file to another.

One solution is to assign a unique number to each unique chemical substance and to use at least that number to identify chemicals in a file, much as a Social Security number is used to identify each individual in the United States. A computerized numbering system for chemicals is presently maintained by the Chemical Abstracts Service, which has assigned numbers to over 4 million substances having more than 6 million names since it was begun in 1965. Use of the CAS registry service by government agencies has been shown to be technically feasible and cost effective, and the Interagency Toxic Substances Data Committee has agreed that all federal agencies should require that registry numbers be obtained for chemicals in their files.[56] It will take several years to run existing government files against this "dictionary" of chemicals, but once it is accomplished and maintained, retrieving information quickly from diverse sources will become possible for the first time. Ultimately, as information files are linked into complex systems—that is, networks—compound-related information retrieval can not only become a mechanical function but can involve many diverse sources simultaneously.

CANCER POLICY

Because environmental influences are so important in producing cancer—it is estimated that 60–90 percent of all cancer is related to artificial and natural agents in the environment—a coordinated government strategy to prevent exposure to carcinogens is literally vital.[57] Development of federal cancer policy is proceeding on three levels. The Toxic Substances Strategy Committee is formulating consistent criteria or principles, to be applied throughout government, for identifying carcinogenic substances. The four health-oriented regulatory agencies that constitute the Interagency Regulatory Liaison Group [58] are an integral part of the Strategy Com-

mittee; as a separate but coordinated effort, the IRLG is preparing detailed guidelines on how to perform cancer risk assessments for use in research and regulatory policy. Finally, each agency will develop policies and procedures for using risk assessments in their regulatory decisions, depending on their individual missions and the laws under which they operate.

Policymakers must use presumptions or judgments as well as solid scientific evidence in deciding how much reliance to place on animal studies. Principles derived from both are the basis for many regulatory decisions.[59] A consensus on the application of science-based judgments to the identification of carcinogens despite the lack of scientific certainty has developed among scientists over the past 30 years. This consensus has been expressed in many scientific advisory reports prepared for the World Health Organization, the National Academy of Sciences, the U.S. Department of Health, Education, and Welfare, and other similar organizations. "Cancer principles"—the principles and overall criteria applied to the identification of substances that pose a risk of cancer to humans—also cover such topics as appropriate species of animals to be used in testing, the types of tumors and other lesions used to indicate a carcinogenic effect, and whether safe exposure levels can be established for carcinogens. It is principles such as these that the Toxic Substances Strategy Committee is now formulating for use throughout the federal government.

The guidelines under preparation by the IRLG are more detailed. They concern, for example, the methods for counting tumors in test populations and quantitative methods for estimating the risk to humans, where appropriate. Regulatory agencies will use these guidelines for their own individual programs.

To avoid the problems and inconsistencies that result from substance-by-substance rulemaking, some agencies are already developing for their own use general principles for identifying and regulating carcinogens. A proposal published in 1977 by the Occupational Safety and Health Administration is the most comprehensive so far of these agency policies.[60] Hearings were held on the OSHA proposal in May through July 1978. The proposal delineates some overall principles, including the principle that substances confirmed as carcinogens in tests in mammals shall be treated as posing a risk of cancer to human beings. It also establishes an automatic "trigger" for regulatory action based on a system which classifies substances as confirmed carcinogens, suspect, or neither, depending on the nature and degree of conclusiveness of the data.

A similar scheme was published in June by the Consumer Product Safety Commission.[61] The CPSC established standards that it will apply for: classifying suspect substances for their potential carginogenic risk; determining how widely products containing these substances are used; and evaluating the potential for human uptake, the effect of regulation on the hazard, and the social and economic consequences of regulations. The statement also prescribed the regu-

latory action likely to be taken following classification and evaluation. For example, the CPSC will not permit a known carcinogen which can be absorbed, inhaled, or ingested to be added intentionally to consumer products unless elimination of the chemical would result in unacceptable economic and social costs.

The OSHA and CPSC policies incorporate similar underlying scientific concepts. They are also alike in using a classification system based on evidence for the carcinogenic potential of chemical substances and in using a predefined threshold for initiating regulatory action. The principal difference between the CPSC and OSHA documents is that the former is not proposed as a rule and will not be legally binding; rather, it is intended to provide general guidance to the CPSC staff, to industry, and to the public.

An automatic requirement which sets in motion a regulatory process for substances of concern to workers or consumers is an important step. In many cases, regulatory responses have been slow; sometimes years have passed between the time that evidence was first available implicating a substance as carcinogenic and the time that regulatory action began. The use of automatic triggers to initiate action should expedite the regulation of carcinogens.

The use of an automatic trigger for regulatory action on the scale proposed by OSHA for carcinogens is unique, although EPA has used an automatic trigger since 1975 as part of its pesticide registration decisions.[62] In the EPA scheme, if certain criteria are met (one of them is evidence in humans or animals that the pesticide is carcinogenic), there is an automatic but rebuttable presumption against registration of the pesticide. The procedures for evaluating whether and to what extent pesticides and other substances pose a risk of cancer to humans were published by EPA on an interim basis in 1976.[63]

INTERNATIONAL TOXIC SUBSTANCES ACTIVITIES

The past year saw unprecedented progress toward international cooperation among industrialized countries in control of toxic substances. There were three principal reasons for the flurry of international action. First, nations are coming to realize that many toxics problems are transnational in nature. Toxic pollutants in waterways cross national boundaries; toxic substances are transported across continents and across oceans by air; and problems result from distribution of toxic chemicals in international commerce, both in bulk form and incorporated into products.

Other toxics problems may occur within the borders of one country but still become a serious multinational concern. For example, an endangered plant or animal species or its critical habitat may be harmed by a toxic substance. The accelerated loss of species caused by human activities is now recognized by many nations as

an international problem,[64] even though the species may be contained within a single country.

Still other toxic problems are truly global, both in effect and in possible solution. An example is the depletion of stratospheric ozone by fluorocarbons.

Even when a problem of toxic chemicals is strictly confined to a single nation, as are some water pollution and waste disposal problems, other nations are grappling with similar situations. Cooperation and information exchange can often speed the development of scientific and technical understanding and mitigation measures.

Nations are beginning to comprehend the international implications of the U.S. Toxic Substances Control Act and similar legislation passed or under consideration in other countries. Recent laws for toxic substances control have been passed by the United States, Canada, France, Japan, Norway, Sweden, Switzerland, and the United Kingdom; other countries such as Australia and the Federal Republic of Germany are considering draft legislation. The Commission of the European Communities is moving to establish by early 1979 a uniform regime for reviewing new chemicals in its nine Common Market member countries.

These new laws have in common the objective of protecting health and the environment by authorizing assessment of the effects of chemicals. They also involve the generation of data by industry to be provided to the government for assessment and possible subsequent regulation. Some of the laws cover only new chemicals. Some existing chemicals, however, are often covered by older laws regulating drugs, pesticides, the workplace, or other situations. In most cases crucial decisions on implementation will be made during the next 1–3 years, so the time is ripe for international cooperation to avoid unnecessary discrepancies and conflicts.[65]

Adverse economic impacts and disruption to international trade could be substantial if one nation's approaches are seriously incompatible with another's in such areas as requirements for testing, premarket notification, data to be submitted on "new" and "existing" chemicals, classification, packaging and labeling of dangerous substances, and regulatory control. One estimate is that nearly 50 percent of world chemical production crosses political frontiers and that world trade in chemicals amounts to more than $75 billion per year.[66]

The new awareness of chemical problems and resulting government requirements are placing a heavy burden on limited technical resources to develop the necessary toxicological data. In addition, risk assessment procedures will require careful development and thoughtful application. It is hoped that international cooperation will reduce duplicative work so that resources may be used most effectively for the common good.

STOCKHOLM

At an ad hoc multinational conference held in Stockholm from April 11 to 13, 1978, representatives from 16 countries and 6 international organizations discussed the international aspects of control of toxic substances and reached general agreement on the need for greater international cooperation. Six areas were selected for immediate attention:

- Development of consistent data requirements and testing methods
- Development of consistent standards for good laboratory practices and effective means of enforcing them
- Mechanisms for information exchange for both substantive data and administrative actions
- Exploration of confidentiality problems, with the goal of ensuring international exchange of health and safety data while providing adequate protection for legitimate trade secrets
- Development of consistent methodologies for analyzing the economic and trade impacts of toxic chemical regulation
- Development of a consistent international glossary of key terms.

It was agreed that most of the immediate effort would be carried on under the auspices of the Organization for Economic Cooperation and Development (OECD), which already sponsors substantial work related to chemicals in the environment. It was also recognized that the World Health Organization had a key role to play in many of the longer-term activities. The meeting urged continued support of programs carried out by other international organizations but cautioned that duplication should be avoided. Most delegations agreed to consider further a future formal international agreement on toxic and hazardous chemicals.[67]

OECD MEETINGS AND ACTIVITIES

The Stockholm meeting was immediately followed by meetings in Paris of the OECD Chemicals Group and its parent Environment Committee, both of which accepted the recommendations for priority work outlined at Stockholm and elaborated them into a more detailed OECD Chemicals Program for 1979.

OECD is composed of 24 noncommunist industrialized nations. In 1977 member nations accounted for approximately 68 percent of worldwide chemical production.[68]

The OECD has been concerned with chemicals in the environment for over 8 years, first in regard to pesticides and later toxic chemicals in general. The Chemicals Group of the Environment Committee has been assessing the potential environmental effects of chemicals. A comprehensive cooperative program among member countries will examine how the numerous new chemicals put on the market each year may be evaluated for possible hazardous effects before commercialization. Projects are also underway on the

exchange of scientific information involving specific chemicals such as PCBs, mercury, and fluorocarbons. A wildlife sampling and analysis program is in progress to determine whether certain wildlife indicators can help gauge the effect of regulatory action on levels of various toxic substances in the environment.[69]

In 1977 the Chemicals Group undertook a project to harmonize the testing procedures associated with regulation of toxic chemicals. Six technical working groups, with membership drawn from various OECD countries, working in the areas of physical chemistry, ecotoxicology, persistence-biodegradation, long-term toxicology, short-term toxicology, and step-sequence testing.[70] The groups met in Washington, D.C., in the spring of 1978 to coordinate their efforts. Work is scheduled for completion by the winter of 1979.

TOXICS–RELATED ACTIVITIES OF OTHER INTERNATIONAL ORGANIZATIONS

The Commission of the European Communities has requested discussions with the United States on a bilateral agreement on the control of new chemicals. A formal meeting in Washington, D.C., in June 1978 followed earlier informal meetings and information. The next formal meeting will be held in Brussels in the fall of 1978 after the publication of the proposed U.S. regulations on the control of new chemicals.[71]

Meanwhile, through seminars and working groups, the UN Economic Commission for Europe, which links the European Communities and OECD countries with those of Eastern Europe, is studying the management of toxic substances from an environmental perspective, for example, possibilities of substituting safer substances for toxic chemicals or recycling to control waste disposal problems.

The International Register of Potentially Toxic Chemicals, conceived at the 1972 Stockholm UN Conference on the Human Environment, is being developed as part of the "Earthwatch" global environmental assessment activity of the United Nations Environment Programme. The Register is intended to be a data network on chemicals, their properties, uses, production, hazardous effects, modes and extent of exposure of target organisms, relevant standards, laws and regulations, and procedures for emergencies, providing information to users such as scientific organizations, private and public institutions, and countries, especially developing nations.[72] The system is not very fully developed at this point, however, and various suggestions are being made for its improvement.

Other organizations concerned with specific aspects of chemicals include the World Health Organization and its International Agency for Research on Cancer, monographs and criteria documents on health effects of chemical substances; the International Labor Organization, worker protection; the Food and Agriculture Organization, chemicals used in agriculture; and NATO's Committee on the Challenges of Modern Society, waste disposal.

INTERNATIONAL DEVELOPMENTS RELATED TO STRATOSPHERIC OZONE DEPLETION

International cooperation to achieve a better understanding of how human activities might result in the depletion of ozone in the stratosphere is continuing. As stratospheric ozone decreases, ultraviolet radiation reaching the earth increases, with possibly very serious global consequences to biological systems, human health, and climate.

A National Academy of Sciences report in December 1977 reiterated the importance of the issue and pointed out that because of revised values for certain critical chemical rate constants, "the estimated seriousness of release of chlorofluoromethanes measured by ozone reduction has been roughly doubled" [73] (compared to a 1976 NAS estimate of an ultimate reduction in ozone of about 7 percent), assuming continued release of chlorofluoromethanes at the 1973 level.[74] The same revision in chemical rate constants had the opposite effect on the estimated impact of NO_x from the exhausts of SST's and other high-flying aircraft; that problem is not now believed to be one of immediate concern.[75] A followup to the 1976 NAS report is expected in late 1978.

The United States and Sweden were the first nations to announce regulations restricting certain nonessential aerosol uses. By mid-1978 regulatory action was under development by Canada and Norway; the Netherlands had proposed a labeling action, and a policy position by the European Communities was directed at a reduction in fluorocarbon use and/or production. Other nations were studying the problem further prior to determining what action to take.[76] As a followup to the April 1977 International Meeting on Regulation of Chlorofluorocarbons in Washington, a similar meeting is planned for December 1978 in the Federal Republic of Germany.

The OECD completed studies of the economic effects of various scenarios of fluorocarbon restrictions and the possibility of substitutes for fluorocarbons.[77] Other international cooperation on research, monitoring, and analysis of results continues through various world organizations, bilateral agreements, and the Tripartite Agreement of the United States, France, and the United Kingdom, which provided a mechanism for analyzing the stratospheric effects of limited flights of the Concorde supersonic transport.

Much of the international research is being carried on in conjunction with the United Nations Environment Programme World Plan of Action on the Ozone Layer, adopted in 1977. The UNEP Plan of Action describes 21 research-oriented activities in three categories—the natural ozone layer and its modification by human activities; the impact of changes in the ozone layer on people, the biosphere, and climate; and socioeconomic aspects. The status of national and international research programs is reported through a semiannual UNEP bulletin.[78]

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CHAPTER 5

HUMAN SETTLEMENTS

CHANGES IN POPULATION PATTERNS

> The seemingly iron cast pattern of rural to urban migration and its social effects on the quality of life in both the metropolis and the countryside are well known. The population of the United States is becoming Balkanized along the coasts and the Great Lakes, while hundreds of small towns struggle for their existence, quietly drying up in the corner of a national greenhouse whose basic premise is bigness.[1]

Senator Sam Nunn's description of U.S. population trends reflects a view still widely shared. It is based on the long-continued migration away from rural areas into cities, a shift that became massive after World War I and continued into the 1960's. In fact, in 1973 when Senator Nunn observed a "seemingly iron cast" pattern, it had already changed. Since 1970 our fastest population growth has been in rural areas, not the cities. Indeed, people are moving out of our largest cities in substantial numbers.

The peak of the rural-to-urban migration within the United States had passed by the mid-1960's. From 1960 to 1970, 2.2 million people —many coming from farms that had been consolidated—shifted to the cities. But this number was less than half the migration of 5.5 million people in the 1950's. By the late sixties, the rural-to-urban movement was no longer a dominant social force, although for several years public policies still reacted to problems associated with the historic pattern. Only very recently has the changing pattern become apparent, and public policy is only now beginning to address the new issues arising from the changed trends.

URBAN POPULATION DECLINE

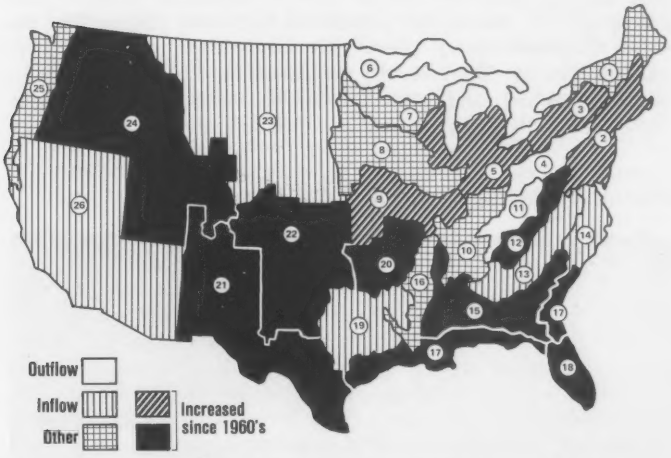
Although most metropolitan areas are still growing, an increasing number of the nation's large cities are showing population declines. Among them, only Pittsburgh lost population in the 1960's; it was joined in the first half of the 1970's by New York, Chicago, Los Angeles, Detroit, Seattle, Cleveland, St. Louis, and many others.[2] The reason is outmigration to the suburbs and rural areas. The nation's largest metropolitan areas experienced a net outmigration

of about 2.2 million people from 1970 to 1976, in contrast with the net inmigration of 1.8 million in the 1960's.[3] Of the 20 largest urban areas, 11 are in the Northeast and North Central areas—all showed net outmigration between 1970 and 1976.[4]

Despite the demonstrable reduction of urban growth, no urban area in the 1970's is declining at the rates of 30–50 percent that rural counties experienced during several previous decades. Further, cities in the South and some in the West are still growing, the large ones more slowly than in the 1960's. Suburban growth continues, but again at slower rates; metropolitan fringe counties—those adjacent to the urbanized counties—are growing more rapidly. Figure 5–1 shows these growth trends by region.

Figure 5-1

Metropolitan County Migration 1970-75



1. Northern New England - St. Lawrence
2. Northeastern Metropolitan Belt
3. Mohawk Valley and New York Pennsylvania Border
4. North Appalachian Coal Fields
5. Lower Great Lakes Industrial
6. Upper Great Lakes
7. Dairy Belt
8. Central Corn Belt
9. Southern Corn Belt
10. Southern Interior Uplands
11. Southern Appalachian Coal Fields
12. Blue Ridge, Great Smokies, and Great Valley
13. Southern Piedmont
14. Coastal Plain Tobacco and Peanut Belt
15. Old Coastal Plain Cotton Belt
16. Mississippi Delta
17. Gulf of Mexico and South Atlantic Coast
18. Florida Penninsula
19. East Texas and Adjoining Coastal Plain
20. Ozark - Ouachita Uplands
21. Rio Grande
22. Southern Great Plains
23. Northern Great Plains
24. Rocky Mountains, Morman Valleys, and Columbia Basin
25. Northern Pacific Coast (including Alaska)
26. The Southwest (including Hawaii)

Source: Peter A. Morrison, *Current Demographic Change in Regions of the United States*, (Santa Monica: The Rand Corporation, 1977), p. 19.

There is increasing evidence that recent overall urban population figures may mask some important signs of reviving life in the central cities. In many older cities, significant rehabilitation efforts are taking place,[5] and the affluent middle class which abandoned central city neighborhoods decades earlier is returning. The trend back to the city seems to involve primarily renovated older buildings and neighborhoods, although some new construction is also occurring in bypassed city lots and undeveloped pockets.

The migration out of metropolitan areas and the movement into rural areas—both well-documented by now—may seem to cast doubt on any significant back-to-the-city movement. Yet although statistical data for central cities are lacking, the trend does appear to be real and may be accelerating. The paradox may be explained by the fact that the newer residents typically have small households and children are few; therefore a neighborhood may be lower in population after renovation than before. Whether the city as a whole loses population depends on where the displaced residents find housing. Thus the mix of a city's population appears to be changing, with important implications for urban policies (see the urban discussion below). Overall, growth in urban population is apparently slowing. However, the population balance between metropolitan areas and rural or small town communities has not yet been significantly altered by the recent net outmigration from the cities.

RURAL GROWTH

Perhaps the most remarkable change in population trends from the 1960's is the turnaround in growth rates of nonmetropolitan areas. In contrast to the general pattern since the Industrial Revolution, these areas now grow faster than most cities. From 1970 through 1976 the nonmetropolitan population increased by 6.6 percent, compared with metropolitan growth of 4.1 percent. In the last decade of the sixties, less than 10 percent of growth went into rural areas. These same rural areas, which contained 27 percent of the U.S. population in 1970, acquired 37 percent of national growth in the 5 years following. If present trends continue, the net addition to the present nonmetropolitan areas could exceed 5 million people by 1985 and 15 million by the end of the century.[6]

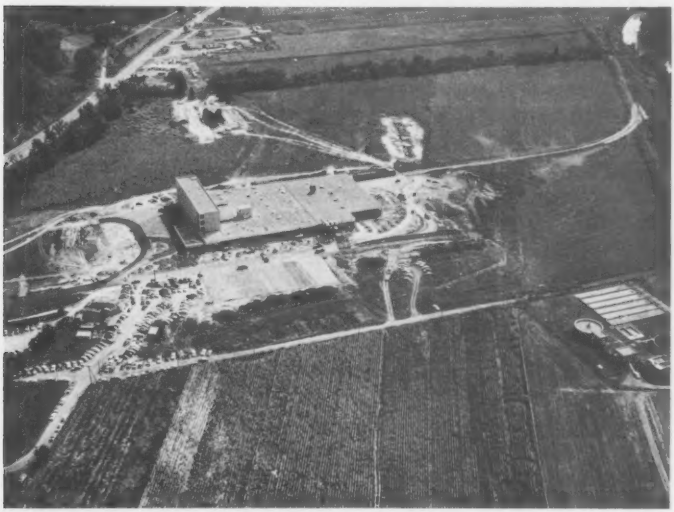
The most striking reversal in trends is in counties with the lowest population density—10 people or less per square mile and no towns with more than 2,500 inhabitants; it is here that the highest growth in migration rates is occurring. As recently as the 1960's, these same counties continually lost population by outmigration, mostly of younger people.[7]

More than one-half the recent rural growth has come from net inmigration, which amounted to 1.8 million people from 1970 to 1975. Several factors have contributed to the new pattern:

- In the 1950's and 1960's, rural areas lost an average of 200,000 jobs per year in farming and mining. Since 1970 there have

been minor drops in farm employment(27,000 annually), but they were offset by increases in coal and other mining activities.[8]

- Other kinds of employment in rural areas and small towns have also increased. Following the decentralization of manufacturing in the 1960's, jobs developed in support industries, services, trade, and construction. These trends have continued, although rural counties that depend heavily on manufacturing jobs grew at less than the average rate for nonmetropolitan counties from 1970 to 1976.[9] Recreation and retirement have both become major spurs to growth of service jobs in attractive rural areas. Government and colleges have also created important employment opportunities in rural areas.[10] Total nonfarm employment in nonmetropolitan areas grew by about 22 percent from 1970 to 1977, double the growth rate in metropolitan areas.
- The settlement of retired people in nonmetropolitan counties has increased greatly. Retirement settlement continues in the traditional areas of Florida and the Southwest but is also growing in such diverse rural places as the old cutover region of the upper Great Lakes (especially Michigan), the Ozarks, the hill country of central Texas and the east Texas Coastal Plains, the Sierra Nevada foothills in California, and northern and coastal New England.[11] Counties identified in the 1960's as having a substantial inmigration of older people are by far the most rapidly growing class of nonmetropolitan counties in the 1970's.[12] "Retirement counties" is probably too narrow a label for some of these counties. For one thing, the same amenities draw both



Manufacturing plants in rural areas create new jobs in support services and construction—in this case at the expense of prime farmland.

recreation and retirement activities and may also attract younger families to settle in the area. In addition, the very influx of older people into attractive areas can subsequently stimulate jobs for younger people, laying the foundation for permanent rural jobs and population growth. In approximately three-eighths of identifiable "retirement" counties where there was an inmigration rate of at least 15 percent of white people 60 years or older, inmigration of younger people was still higher.[13]

- Nonmonetary objectives appear to influence many migrants leaving the cities for rural communities. In the 1950's and 1960's high county income was closely related to high population growth and low income with heavy population loss. This pattern no longer prevails. It is the low- and middle-income nonmetropolitan counties that have had the greatest reversal in population trends. Some of this growth reflects inmigration by retired people seeking lower-cost living areas, but field interviews indicate that many new settlers are motivated by a high regard for the values of rural or small town life.[14]
- Extension of transportation over the past 100 years fostered first the growth of suburbs, then exurbs, and most recently a new scattered rural life. The National Interstate Highway System, now 92 percent complete, makes it easier to commute from the country to employment in many metropolitan areas.

To a degree, nonmetropolitan population growth is simply an extension of suburban sprawl. Rural counties outside the SMSA but adjacent to metropolitan counties now increasingly serve as part of the metropolitan region.

But this fact alone does not explain nonmetropolitan growth. Growth rates of adjacent and nonadjacent rural counties have become increasingly similar. A decade ago, adjacent counties grew five times as fast as the counties more distant from metropolitan influence. But from 1970 to 1976 nonadjacent rural counties grew at about 85 percent of the rate of adjacent counties. One analyst concludes: "[T]he pattern of U.S. settlement has evolved beyond the point where nearness to a metropolis is a prerequisite to local migratory growth. The cultures of city slicker and country bumpkin have merged—with an assist from television and the federal highway program—and Safeways, Sears, and Sizzlers have diffused down the urban hierarchy to serve even small and remote settlements." [15] This phenomenon, sometimes termed "leapfrog" or "buckshot" urbanization, has created a variety of new environmental and land use problems.

Large "preplanned" recreational subdivisions, many of 1,000 acres or more, and individual second homes have been constructed in sensitive environmental areas, floodplains and wetlands, mountain tops and steep slopes, and hazardous areas. These developments have directly or indirectly destroyed natural ecosystems, amenities, and wildlife habitat, polluted ground and surface water, eroded hillsides and removed vegetation which protected land from the

ravages of wind and water, caused air pollution from automobiles and dusty roads, and created solid waste and litter problems. Many have drastically and quickly changed the character of rural towns and villages.[16]

Although these problems occur regularly in the urban fringe, in rural areas their impact is often more severe. Rural planning capabilities and land use controls, where they exist, frequently cannot anticipate or regulate the rapid pace of new development, and rural fiscal resources often cannot meet the new demands for public services—for sewers, schools, medical facilities, and police and fire protection—that new residents create. For managers of the nation's public lands, recreational development on adjacent property has created major law enforcement, wildlife and habitat protection, and fire protection headaches and new pressures to permit private sewer, distribution line, and roadway easements to the detriment of traditional public land management goals and practices.[17] For agricultural interests, buckshot urbanization has created a host of other economic problems. (See the discussion of prime and unique farmlands in Chapter 6.)

REGIONAL POPULATION SHIFTS

By 1980 the center of U.S. population may lie west of the Mississippi River—a symbolic milestone. But the center has moved westward ever since the first census and has been heading south in each decade since 1910. Discussion of the countrywide population shifts in terms of the catchwords "Sunbelt" and "Snowbelt" is, therefore, somewhat misleading. There has indeed been an important shift of population from the North to the South, but the historic shift to the West, regardless of latitude or climate, has continued, and extensive growth is also occurring in many rural parts of the Snowbelt.

From 1970 to 1976 the total population of the Northeast and North Central regions—an area that contains 90 million people—grew by little more than 1 percent; in fact, the Northeast has shown a net population decline. The western and southern States increased by 10 percent. This growth rate is similar to that of the 1960's in these regions, except that more growth now comes from inmigration than from birth. In the Northeast and East North Central states, on the other hand, current growth is barely one-fifth of that of the 1960's because of the combined effects of outmigration and lower fertility.[18]

The change in regional growth rates is dramatic. From the 1940's through the 1960's the Northeast and North Central regions accounted for about 40 percent of the nation's population growth; in the 1970's, their share was only 14 percent. Most of the compensating increase is in the South, where populations that were stable or declining in earlier decades because of the rural exodus have now resumed growth.

Population growth rates in the Mountain and Pacific West have been far above the national average since the 1850's when comparisons were first possible. The key change in this region is that California's former dominance in western growth has ended. It is still by far the most populous western state, but for the first time since 1920 most western population growth occurs outside California. In the other western states, energy development, manufacturing, recreation, and retirement settlement are all booming, and a relatively young population and high birth rate cause twice as many births as deaths. Despite low population densities, the absolute increases are becoming impressive.

Within broader regions, several subregions showed exceptionally rapid growth between 1970 and 1973. The Ozark-Ouachita area increased by 9.4 percent, the upper Great Lakes by 8.0 percent, and the Rocky Mountains by 7.1 percent. Most notably, the Southern Appalachian coal fields region grew by 6.3 percent, in contrast with a 13 percent loss in the 1960's. The two direct inducements to subregional growth appear to be energy production in the Rocky Mountains and Appalachia and the spread of retirement communities elsewhere.

U.S. URBAN AREAS

URBAN PROBLEMS

National and regional settlement patterns of the 1970's have caused or exacerbated a variety of urban environmental problems. The central cities have, in general, lost even more jobs than before, their fiscal resources have declined, their ability to provide services has diminished, and their physical deterioration has increased. In our older cities, public buildings, schools, and streets needing repair or improvements have suffered from revenue losses caused by the flight of businesses and the middle classes to the suburbs. For the higher concentration of minorities and the poor that remain behind, city fiscal problems have strained efforts to improve the quality of housing, schools, medical care, and protection against crime—all critical elements of urban environmental quality. In older cities as a whole, public parks and recreation facilities, urban trees, and the maintenance of trash collection and other public services have similarly suffered, again affecting the poor most of all.

But for all residents, the attraction of many cities as vital commercial, entertainment, and cultural centers has been diminished, if not replaced, by the growth of large shopping and entertainment centers in the wealthier and growing suburbs. Old and new cities continue to be plagued by transportation problems, notably by high speed commuter highways which have long since disrupted or destroyed urban neighborhoods and which now cause severe urban air pollution as they bring suburban and rural residents in and out of the central city each day.

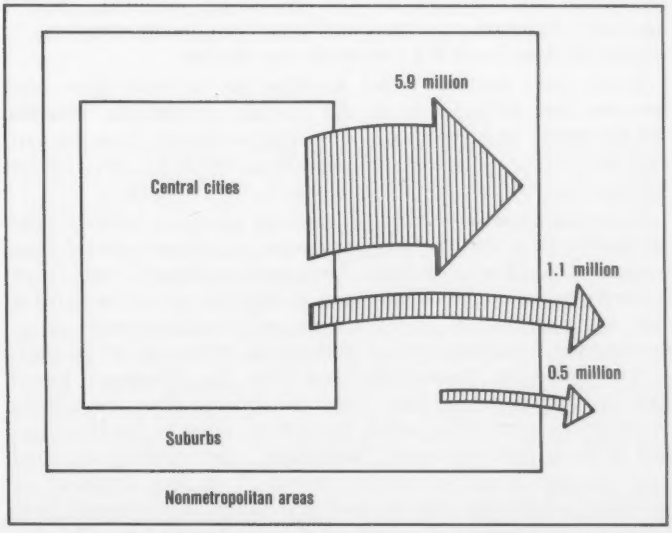
Although many of these urban problems began after World War II —and some before—they have become exaggerated by recent population trends, particularly by the rapid loss of population from central cities, an exodus that was four times faster in the 1970's than in the 1960's.[19] These trends and the important new shifts to nonmetropolitan areas are illustrated in Figure 5–2. In total numbers, net outmigration of the middle class from the central cities is continuing.[20]

Private jobs in central cities actually grew from 1960 to 1970; they declined from 1970 to 1975. The recessions of the seventies hurt suburban areas, but they hurt the cities more. In 1976 the central city unemployment rate was 9.2 percent, 2 percent higher than in suburban areas.[21] Since 1970 minorities have been particularly hit by the central city unemployment rate. Whereas in 1970, 7.5 percent of blacks in the central city labor force were unemployed, by 1975 the figure reached 14.1 percent.[22]

Income disparities between suburbs and central cities are widening. Personal incomes grew almost twice as rapidly in suburbs as in cities between 1960 and 1973. Although there is some evidence that the new inmigration of poor people into cities is declining, central cities still provide shelter for a disproportionate share of impoverished

Figure 5-2

Migration from Central Cities 1970-75



Source: The President's Urban and Regional Policy Group, *A New Partnership To Conserve America's Communities* (Washington, D.C.: U.S. Government Printing Office, 1978), p. I-10a.

households and minorities. In 1974, 36 percent of the poor lived in central cities compared to 30 percent in 1959.[23] Housing in urban areas has become a major problem as housing options diminish and housing stocks deteriorate. Because many urban residents are poor, their choice of housing is exceptionally restricted by current high prices. In addition, the supply of capital for housing is scarce and costly or unpredictable. Rates for private loans are high and redlining makes loans unavailable in some neighborhoods.

The concentration of the poor in cities leads to acute financial distress. A disproportionate share of taxable wealth and incomes is in the suburbs, and a high service-cost population has remained in the central city. Everywhere outside the South, per capita spending by central city governments for purposes other than schools increased much faster than those of suburban governments from 1972 to 1975.[24] Indeed, expenditures in most distressed cities are growing much faster than increases in the value of real property, the chief tax base in most municipalities. Spending increases in older cities have slowed down in the past 3 years, but in high strain cities absolute reductions in service levels have been necessary to bring spending in line with tax revenues.

Physical deterioration of public facilities—schools, roads, parks, and the like—and underuse of existing urban facilities are also characteristic of cities that no longer have an adequate tax base. In one year, 1976–77, nine large and severely distressed cities cut back their capital spending by 17.2 percent.[25]

Even while the physical plant runs down and wears out and services decline, there is little relief for the city taxpayer. In 1970 local taxes required a payment of 9.1 percent of resident income in central cities and only 6.8 percent in the suburbs.

In the most distressed cities, spending has to grow faster than revenues, just to stay even in the provision of services. Whether the city resorts to higher taxes or reduced services to close the gap, the consequence is further outmigration, which in turn further weakens the tax base and deepens the downward spiral.

It is generally agreed that the principal causes of urban decline are private, economic, and social forces such as technological change, regional disparities in business costs, and residential preferences. Nevertheless, federal, state, and local government policy has in many cases aggravated urban problems. State and local annexation policy, for example, has a powerful, if unintended, effect. In certain parts of the South (e.g., Jacksonville) and West (e.g., Houston), liberal state annexation policies have permitted cities to share the benefits of growth in surrounding areas. In contrast, cities in the Northeast and Midwest have remained "landlocked," permanently separated from the growth in surrounding suburbs.[26] If San Antonio, for example, had the same boundaries that it had in 1944, it would have a higher concentration of poverty and unemployment than the disadvantaged aging cities of the North (such as Trenton).[27]

Several major federal programs and policies have reinforced—often inadvertently—the trends that cause cities to decline. Examples are federal funding of water and sewer systems that have favored construction of new facilities over rehabilitation of old ones, federal highway construction that has encouraged rural and suburban growth and tended to hasten the destruction of some urban communities, location of federal facilities in suburban rather than central city regions, procurement of federal goods and services without regard to their urban impact, and failure to target the extensive federal aid already given to localities with distressed urban areas.[28]

The alarming fiscal, unemployment, and population trends affecting many of the nation's communities, particularly the older cities of the Northeast and North Central regions, impelled a new reassessment of federal urban responsibilities and programs.

In March 1977 President Carter directed the Secretary of Housing and Urban Development to examine together with other agencies all aspects of present federal activities as they affect urban areas and to develop an urban and regional policy for the federal government. The effort reflected growing awareness of the need to understand and redirect federal policies that might inadvertently add to the distress of hard-pressed cities.

URBAN POLICY

In proposing a National Urban Policy on March 27, 1978, President Carter emphasized a "new partnership" among all levels of government, the private sector, and neighborhood and voluntary organizations to make the cities better places in which to live and work.[29]

Citywide Problems

The basic persistent, broad structural problem of cities—unemployment, deteriorated physical conditions, and inadequate public services—were the target of major proposals in the urban program. Some of these proposals are new; most combine the older federal programs with measures recently put into effect to aid cities in distress. All of these proposals offer funds to be administered largely at a city's discretion. Some proposals give cities wide latitude in selecting the problems or geographic areas to receive assistance, and others tie assistance more closely to particular places or problems.

The General Revenue Sharing Program, under which the federal government allocates funds by formula to state and local governments for their general use, has been the broadest federal assistance program to cities. This program, however, lacks sensitivity to the special needs of hard-pressed cities having a disproportionate share of the poor. The "countercyclical" assistance program tied to unemployment rates, has helped bring federal aid to some of the neediest cities, but because it phases out when unemployment drops

Renovation of older homes provides needed housing and employment for city residents and helps in preserving neighborhoods.

below 6 percent, its disappearance could leave many cities facing serious fiscal strain. The President's urban program proposed to replace countercyclical funding with a 2-year $1 billion supplemental fiscal assistance program which would channel aid to communities experiencing severe financial hardship in the next few years.

To encourage states to do their share in supporting urban areas, the President proposed a new program of state incentive grants, amounting to $400 million over 2 years. States which develop

approved plans to help needy communities, in collaboration with those communities, will be eligible for the grants.

To increase urban jobs, the Urban Policy called for a short-run labor-intensive "soft" public works program aimed at assisting the persistently unemployed. Local governments will set priorities, choosing from a list of labor-intensive public works that will improve the quality of the urban environment. Typical projects involve repair and maintenance of deteriorating public facilities (including those of historic, cultural, or other value), maintenance of recreation facilities, and assistance for energy conservation, such as insulation of public buildings.

Other proposed measures would encourage businesses to hire the hardcore unemployed and would extend employment and training opportunities under the Comprehensive Employment and Training Act.[30] Also proposed were a national development bank for long-term, low-cost business loans, a special tax incentive for firms to locate in economically distressed areas, an increase in economic development grants, and other incentives to help rebuild the private sector within urban economies over the long run.

In the months prior to the Urban Message, the federal government took several steps to help rebuild cities' rundown physical plants. The Community Development Block Grant Program administered by the Department of Housing and Urban Development was extended for another 3 years. Both the statutory formula and revised HUD regulations for allocating CDBG funds focused on older cities with deteriorating facilities, housing deficiencies, and large numbers of poor people.

Other Administration proposals for urban needs and services included a 30 percent increase in overall federal assistance to education, with special emphasis on large city school systems with concentrations of children from low-income families, comprehensive welfare reform, creation of a consumer cooperative bank, and extra funds for capital investments in urban transportation.

The City as the Sum of its Parts

The strength of urban areas rests largely on the health of the various parts of urban areas, including commercial centers and residential neighborhoods. The relation is reciprocal, of course. As the broad citywide fiscal, jobs, welfare, and physical development measures outlined above help to improve the health of cities as a whole, the smaller, discrete parts of the city, such as urban neighborhoods and commercial centers, will also fare better. Direct support for special urban areas, notably neighborhood efforts to improve or maintain themselves, is also an essential element in comprehensive aid to cities. Federal measures to help neighborhood projects and to revive deteriorated business areas, to be undertaken with the approval of local elected officials, were important ingredients of the President's program.

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The most conspicuous Administration initiative to combat major pockets of poverty or distress in urban areas is the $400 million Urban Development Action Grant program. By concentrating program grants for major redevelopment projects in communities with the greatest distress, the government sought to target its funds quickly to areas most likely to draw additional private investment—to have a leveraging effect.

UDAG projects in several dozen cities were first announced in April 1978. Grants of $1 million for housing in Newark were to be accompanied by a commitment of $8.5 million in private funds, for example, and a grant of $4.8 million for a central business district project in St. Paul was to be accompanied by a $74.1 million private commitment.[31] Many of these early grants were for large hotels and other commercial projects that were on the shelf and ready for immediate construction. In response to criticism from many urban groups that neighborhood, housing, and other participants were being neglected, HUD made it clear that applications for neighborhood projects would be given high priority.[32]

Rehabilitation of rundown houses and businesses—recycling the city physically and preserving the spirit of existing neighborhoods—received strong support in the urban program. The federal government's major categorical program for rehabilitation, HUD's Section 312 rehabilitation loan program, was increased to $245 million per year, this time to include multifamily properties. Section 312 funds, along with rehabilitation done by communities using their block grants, will continue to provide important aid to reinvigorate cities and neighborhoods.

New initiatives for government-supported neighborhood action were flexible, small scale, and often experimental. Among them were proposals to encourage volunteer work, strong neighborhood associations, and local financing to meet neighborhood needs. Specifically, the urban program included a proposed $40 million Urban Volunteer Corps to be administered by ACTION, a $15 million self-help development program for neighborhood associations administered by HUD's Neighborhood Office, a $20 million Livable Cities program to enhance neighborhoods and encourage community pride, and a $10 million joint ACTION—Law Enforcement Assistance Administration neighborhood crime prevention program. The new local financing proposals included community development credit unions and pilot programs for neighborhood commercial reinvestment centers drawing on private lending institutions, emulating the housing credit work pioneered by the Urban Reinvestment Task Force.[33] A fund of $20 million could be available as startup money for neighborhood-based community development corporations.

Achievements of small-scale neighborhood programs have already been demonstrated in many places in the country. Two groups which have received national attention for their efforts and which have counseled fledgling neighborhood groups elsewhere are the South-

east Community Organization of Baltimore and the People's Development Corporation in the South Bronx of New York City.[34]

The SECO experience illustrates what can be done with a partnership of federal, state, local, and public interests. SECO began as a grassroots neighborhood initiative and expanded to attract foundation support, help from a small experimental federal program, funds from the city, and eventually substantial money from private lending institutions. From its origins as a neighborhood defense effort against a highway, SECO has moved into supporting home rehabilitation and has lately evolved to support broader community development, including commercial enterprises, with federal help.

Southeast Baltimore is a patchwork of Polish, Greek, Italian, German, Slavic, and Irish neighborhoods. Its population of 94,000 also includes Appalachians, Blacks, and American Indians.

During the sixties as upwardly mobile residents moved to the suburbs, southeast Baltimore began to show the typical signs of urban decay—deteriorating and abandoned housing, trash-strewn vacant lots, industrial pollution and encroachment into residential areas, decline in the quality of public school education, and inadequate public services for the young and elderly. With these events came gradual and widespread decisions by local financial institutions not to invest in certain neighborhoods—a practice called "redlining." Looming over all these issues was the threat of an urban expressway planned to run directly through southeast Baltimore.

In the late 1960's, as the city began condemning rights-of-way and tearing down housing in two neighborhoods, community residents banded together to form the Southeast Council against the Road. SCAR's cause not only galvanized other neighborhoods potentially affected by the expressway but also led southeast citizens to recognize other common interests. The neighborhoods subsequently organized to stop the closing of a library and to resist a wholesale area rezoning.

By 1971, 90 neighborhood groups through a community congress formed the Southeast Community Organization to represent the interests of southeast neighborhoods in housing, education, social services, and health as well as in the freeway. Funding for two community organizers by the National Center for Urban Ethnic Affairs and a community development grant from the Ford Foundation helped SECO plan ways for residents to rehabilitate deteriorating housing, promote homeownership, and overcome redlining.

A major result of SECO's planning efforts was the creation in 1974 of a Neighborhood Housing Services program, a nonprofit neighborhood-based corporation established to coordinate reinvestment efforts. Initial seed money for the NHS Program's operating expenses and a revolving rehabilitation fund was provided by grants from the Ford Foundation and the Urban Reinvestment Task Force, a small federal program led by the Federal Home Loan Bank Board. Subsequent operating funds as well as substantial rehabilitation and

mortgage loan commitments came from local savings and loan associations.

The leveraging effect achieved by the NHS program became substantial indeed, as illustrated by the Table 5–1 summary of rehabilitation loan commitments made during the program's first 3 years. When making residential rehabilitation loans, NHS not only provides financial assistance but also helps with the preparation of job specifications and monitors and inspects all work in progress.

Table 5-1

Funds for Southeast Baltimore Rehabilitation

Source of loan funds	Number of loans	Aggregate amount
NHS revolving fund	140	$ 609,000
City of Baltimore	62	796,000
Savings and loan associations	297	2,552,000
Total	499	$3,956,000

Source: Neighborhood Housing Services Program, *Baltimore NHS—Third Annual Report* (Baltimore, 1978), Appendix A.

Because homeownership is viewed as important to neighborhood stability, NHS has also concentrated on helping tenants purchase their homes and on ways to attract new homeowners. NHS has bought, rehabilitated, and sold 76 vacant houses and assisted 245 families in buying homes in the area.[35]

Wishing to expand its development activities beyond residential rehabilitation, SECO also established Southeast Development, Inc. in 1975, a nonprofit community development corporation funded by grants from the Economic Development Administration and the Office of Minority Business Enterprise. Through a number of spin-off corporations, Southeast Development, Inc. is engaged in a comprehensive program of neighborhood revitalization projects, including land banking, housing purchase, rehabilitation and rental, community health services, health care, commercial revitalization, and home maintenance. Most of the corporation's activities involve creative partnerships among community residents, local government, private lenders, and federal agencies. Each project is designed to leverage private financing and to become self-sustaining after initial direct federal and/or foundation funding.

Neighborhood programs in New York City's South Bronx had a different genesis. The Bronx experience illustrates another mix of city, state, and federal assistance for a project that is based on neighborhood self-help and hard work. Amid the apathy and despair in the burned-out South Bronx, a group emerged in December of 1974 to form the People's Development Corporation, a nonprofit organization covering a nine-block area of the Morrisania section of the South Bronx. The group embarked on a neighborhood improvement mission with virtually no money; its only resource was labor. PDC is committed to the revitalization of the neighborhood through

sweat-equity housing rehabilitation, locally based economic development, and the productive use of local resources.

Before receiving any commitment for funds, a group of community residents started to clear the debris from an owner-abandoned apartment complex at 1186 Washington Avenue. Initial funds came from small grants from private foundations, and equipment came from the New York City Department of Pest Control. A year and a half later, after battling considerable red tape and putting in long hours of volunteer labor, PDC secured a New York City Municipal Loan for $311,000 to rehabilitate the property and a job contract from the Criminal Justice Coordinating Council for job training.

PDC's ultimate goal is to develop a self-sustaining community modeled after a Chinese commune rebuilt after World War II that ultimately became self-sufficient.[36]

Toward this goal, PDC has become involved in several projects to recycle resources, conserve energy, and make use of solar energy. Tenants in buildings managed by PDC have divided their garbage into glass, metal, biodegradables, and rubber and plastics and recycle 95 percent of their wastes. The project yields approximately $10,000 annually for each building and provides two jobs for residents in each building. PDC has an aquaculture project to grow fish for the residents' consumption and grows worms to feed the fish at the same time. Worm castings fertilize their urban garden. PDC also uses various funding sources and techniques to provide the community with cost-effective energy conservation and with a small HUD grant has installed solar reflectors and a new cost-effective hot water system.

PDC currently manages seven buildings with 200 units through New York City's Housing and Development Program. It plans to rehabilitate seven other buildings with 85 units and to rehabilitate two private houses with help from the New York State Youth Program. The young people will assist in the design and rehabilitation of the houses and will ultimately live in them as group home residents as an alternative to being placed in institutions outside their communities; PDC will assist the residents to receive training in architecture or engineering.

Because of its success and innovation, PDC was selected as one of the neighborhood organizations that will participate in the National Urban Homesteading Demonstration Program, and as a result it will receive from HUD $3 million of Section 312 loan funds for renovation.

The City as the Focal Point

Reduction of urban sprawl and creation of more livable cities are two emerging and interrelated federal strategies which are reflected by the Urban Message.

During the effort to develop a National Urban Policy, numerous federal policies and programs were identified which direct resources away from central cities to the urban fringe. Many of these activities

have no direct relation to urban policy, yet have a powerful influence on urban patterns, leading to the inefficient, resource-intensive development known as "urban sprawl." Examples are location of federally assisted highways and interceptor sewers which encourage sprawl, tax laws that favor new investment over investment in existing facilities or homeowners over renters, and location of federal facilities in suburban areas or beyond.[37]

The President promised to make more than 150 improvements to correct antiurban bias in federal programs, including increased government procurement by the Defense Department in urban areas, greater effort by the General Services Administration to locate federal facilities in cities, modification of EPA's water and sewer program to discourage sprawl, and common planning and grant application requirements by HUD and EPA.[38] Federal agencies will also be required to analyze the urban impact of major new domestic initiatives to avoid "inadvertent actions which contradict the goals of the urban policy."[39]

Recent studies have placed renewed emphasis on the ability of attractive cities to draw people and jobs to urban areas.[40] Cities are magnetic largely because of the variety of services and amenities to be found there and the richness of the cultural resources that they offer. Among the proposals in the urban policy message to make cities more pleasant places to live and work is an expanded Livable Cities program. The program will encourage civic art, providing grants to neighborhood and community-based arts programs. It will also offer a new $150 million challenge grant program to revive and rebuild parks and recreation facilities.

URBAN AMENITIES

Provision of decent housing in a healthy environment with clean air and water remain key concerns in any urban area. However, enhancing this environment with amenities like open space, parks, and recreation is important to the quality of life for all urban dwellers. This past year several aspects of urban amenities have received special attention.

Recreation and Open Space

In May 1978, President Carter proposed to Congress $150 million in annual federal matching grants to help local governments establish and rehabilitate needed indoor and outdoor park and recreation programs. The 5-year grant program, to be administered by the Secretary of Interior, called for local governments meeting specific eligibility and need requirements to submit complete plans for rehabilitation and maintenance of parks and recreation systems in order to receive 50 percent federal grants. Additional federal funds would be available to match state contributions to local recreation-rehabilitation projects. The proposed new legislation reflected growing recognition

that recreation is closely tied to the quality and economic vitality of urban life.

The recreation problems of cities were illustrated in the 18-month study of urban recreation and open space preservation undertaken by the Department of the Interior at the direction of the Congress. The study drew these major conclusions:

- No national strategy exists to meet vital urban, recreational, and open space needs.
- Lack of coordination among the federal, state, and local agencies now providing recreation decreases the usefulness of existing programs.
- Most public recreation programs in most cities are underfinanced, understaffed, limited in scope, and poorly distributed and serve the needs of no more than small segments of the population.[41]

In many older cities, park and recreation systems have suffered from protracted disinvestment; some have less money for recreation now than they did 5 years ago. Operation and maintenance of existing facilities are particularly pressing problems for all cities studied. Declining urban centers like Cleveland, Trenton, and Camden spend more than 95 percent of their recreation budgets on operations, with little to spare for repairs or renewal, much less expansion. In the larger, older cities, recreation facilities are deteriorated and out of date, and the oldest and most dense cities tend to have the least park and recreation land. Crime and vandalism also plague recreation programs in nearly every city.[42]

Not surprisingly, the worst deficiencies are in the inner cores of the nation's largest cities. Core city neighborhoods have lost more recreational facilities—or have had access blocked by physical barriers (such as highways)—than other neighborhoods. Access to recreation is a general problem for the urban poor. Over 90 percent of trips to National Parks, regional parks, and other significant recreational areas are made in private vehicles[43]; yet 40 percent of all central city households are without automobiles.[44] Less than 10 percent of the cities sampled in a study have adequate public transportation to nearby regional park and recreational areas.[45]

In a number of cities, abandoned, underused, or decaying areas have the potential to be reshaped for public recreation. Schools, for example, could be more effectively used for indoor recreation.[46]

Adequate and varied recreation opportunities for urban residents depend most importantly on effective management of the parks and recreation facilities that now exist in and near cities. In addition, however, there is a need to preserve and manage the urban area open spaces that serve critical environmental, cultural, esthetic, and, in many cases, agricultural or other economic purposes.

The traditional and simplest way to conserve such open space resources is for governments to buy them, and some growing suburban and exurban areas still acquire park and recreation land. But in central cities, where fiscal strains are greatest, acquisition has virtually

stopped. In fact, throughout the country it is increasingly evident that skyrocketing land costs and finite funding sources make it impossible to provide public needs for open space through acquisition alone.[47] Other legal techniques can preserve open space while keeping properties on the public tax roles, thus requiring expensive land purchases only where important recreation, ecological, or cultural values cannot otherwise be obtained.

Areas in and around cities that are most amenable to protection by techniques other than acquisition include waterfront or underused or abandoned blocks, where recreational and commercial use can be combined, and wooded or open areas on the fringe where recreation can coexist with watershed protection and scenic or agricultural values. Imaginative use of a number of easement purchases, leasebacks, and other but often underused legal preservation techniques can contribute greatly to urban recreation at a reasonable cost.[48]

High property taxes contribute to the loss of urban fringe open space to development. Differential assessment schemes reduce property taxes on undeveloped land by basing assessments on current (usually agricultural) use rather than on market value. Various differential tax measures have been authorized by 44 states to help protect farmland, by 21 states for forest lands, and by 15 to protect open space and environmental areas.[49] Nevertheless, open space preservation requires support by other legal devices as well.[50] Deferred tax penalties often simply postpone rather than rule out changes in the use of land, and, in any event, county participation in differential assessment has been low in urban fringes where its use is most needed.[51]

A variety of techniques for purchase of less than all property ownership rights have been used primarily to protect farmland or scenic beauty in rural areas. There "less than fee" techniques also offer considerable benefit to cities because they can protect open space at the urban fringe. Techniques include agricultural zoning, purchase of the landowner's development rights, and purchase of scenic easements. (See the farmlands section in Chapter 6, Natural Resources, for additional discussion.)

Some of these devices are especially applicable to cities themselves. Requirements that new developers dedicate a certain portion of their projects to public use can be imaginatively combined with other land use controls to create new open spaces and recreation opportunities within our older cities. Commercial waterfronts long neglected in such cities as Boston and Milwaukee offer economic and environmental opportunities that are attracting new attention. So do other neglected urban areas. In New Jersey the regional Hackensack Meadowlands Commission was authorized by the state to direct comprehensive development on the 20,000-acre New Jersey Meadowlands (just north of Newark), which was long an abandoned, polluted, but potentially valuable open space and industrial and commercial area. The intermunicipal commission may prepare plans, issue bonds,

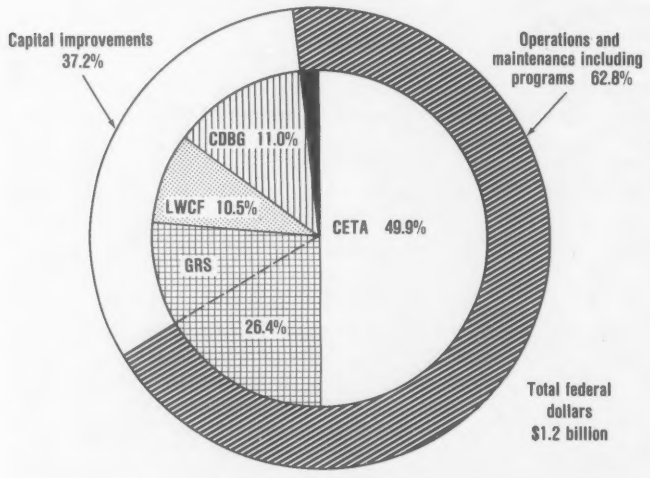
Boston has been restoring its waterfront since the 1960's. Faneuil Hall Marketplace contains offices and shops and has attracted thousands of visitors to the revitalized area since it opened in 1976.

acquire and condemn land, and enforce codes and permits. The use of easements, zoning, and environmental regulations and the dedication by developers of 595 acres of parks and 850 acres of wetlands are designed to create and protect a new urban recreation resource.[52]

Federal money is a powerful source of aid to urban recreation. The major federal money for recreation development and open space acquisition, as shown in Figure 5–3, is the Land and Water Conservation Fund, now administered by the Heritage Conservation and Recreation Service. Forty percent of the LWCF is used by federal land management agencies, and since 1965 it has provided nearly $1.2 billion for federal acquisition of over 1.6 million acres by the

Figure 5-3

Major Sources of Federal Funds for Local Parks and Recreation, Fiscal Year 1976



LWCF—Land and Water Conservation Fund
CDBG—Community Development Block Grant
GRS—General Revenue Sharing
CETA—Comprehensive Employment and Training Program
NYSP—National Youth Sports Program
SYRP—Summer Youth Recreation Program

Source: U.S. Department of the Interior, *National Urban Recreation Study: Executive Report* (Washington, D.C.: U.S. Government Printing Office, 1978), p. 98.

Forest Service, National Park Service, Fish and Wildlife Service, and Bureau of Land Management.[53] Most of these federal lands were acquired to preserve unique natural areas. Few federal acquisitions, however, were near metropolitan areas or related directly to their needs, and such acquisition is not specifically directed by the Fund.

Up to 60 percent of the Fund is apportioned by the Congress to the states. Since 1965, $1.5 billion in Fund money has been matched against state and local funds for acquisition of some 1.6 million acres and for the development of recreation facilities at 14,000 state and local parks.[54]

At the state, as at the federal level, policies for using the Fund have not specifically been directed to meet the needs of urban areas.[55] Of the 10 most populous states (accounting for more than one-half the nation's population), only one, Florida, has obligated LWCF money to urban areas in proportion to the number of people living there.

Overall, the Land and Water Conservation Fund has not provided close-to-home recreation for densely populated urban areas of the nation. Per capita, more than twice as much Fund assistance has gone to rural as to urban areas; further, within metropolitan areas, suburbs have received twice as much money as the core city areas, as shown in Table 5–2. Although a greater absolute share of total LWCF grants has gone to urban than to rural areas, costs of acquisition in the rural areas are generally much lower. As shown in Table 5–3, from 1966 to 1977, only 37 percent of the acreage acquired by state and local governments through the LWCF was in metropolitan areas, where 73 percent of the nation's people live.[56]

Table 5-2

Land and Water Conservation Fund Obligations, Fiscal Years 1965–77

Area	Population (millions)	Obligations (millions)	Average per capita obligation
National total	203.2	$1,470.7	$ 7.24
Rural (non-SMSA [1])	54.9	592.7	10.79
SMSA total	148.3	878.1	5.92
Central cities	61.5	238.8	3.88
Suburban	86.8	639.3	7.36

[1] A Standard Metropolitan Statistical Area is defined as one or more contiguous counties (or cities and towns) containing at least one city of 50,000 population or more or meeting certain other criteria of metropolitan character and social and economic integration with a central city.

Source: U.S. Department of the Interior, Bureau of Outdoor Recreation, "The Land and Water Conservation Fund: Intents and Accomplishments," July 1977.

Table 5-3

Acreage Acquired through Land and Water Conservation Fund Assistance

Fiscal year	SMSA	Non-SMSA	Total
1966	9,568	38,137	47,705
1967	99,596	127,667	227,263
1968	27,761	113,739	141,500
1969	45,835	127,380	173,215
1970	15,745	37,344	53,089
1971	36,941	72,718	109,659
1972	132,193	110,611	242,804
1973	57,175	86,403	143,578
1974	59,127	90,542	149,526
1975	35,692	66,276	101,968
1976	33,808	95,262	129,070
1977	41,838	59,593	101,431

Source: U.S. Department of the Interior, Bureau of Outdoor Recreation, "The Land and Water Conservation Fund: Intents and Accomplishments," July 1977, p. 26.

Financially hard-pressed cities often simply cannot afford the 50 percent match required to use the Fund effectively, with the result that the Fund generally assists communities with matching resources, which may not be those with the greatest open space and recreation needs. Further, the LWCF is statutorily limited to the acquisition of open space and development and rehabilitation of outdoor recreation resources; often, however, the critical needs in cities are for indoor facilities, programs, and the operation and maintenance of existing facilities.[57]

The Community Development Block Grant Program,[58] a public works and capital improvement program administered by HUD, has also been a principal source of federal money for urban recreation and open space since 1974, when it consolidated seven categorical programs of federal aid to cities, including the Open Space Program. Under the Program $683 million was obligated for acquisition of about 350,000 acres of land between 1961 and 1974. At present it provides as much federal grant money for capital assistance as the LWCF. In fiscal year 1976 cities and urban counties spent $132.1 million in CDBG funds on recreation; cities spent 7.3 percent of their grants on land acquisition and park development and only 0.4 percent of the total block grant money on recreation services.[59]

General Revenue Sharing is also an important source of funds for local parks and recreation, providing about $317 million nationwide in the 12 months ending June 30, 1976, which is about 7 percent of all GRS expenditures. Cities of more than 1 million spent the smallest proportion of these funds for recreation.[60]

The Comprehensive Employment and Training Act is playing an important albeit unplanned role in urban recreation. Under the CETA program the federal government gives financial aid largely by formula to state and local sponsors to conduct employment and training programs. Authorized activities include transitional public service employment. In fiscal year 1976, CETA provided almost one-half of all federal dollars spent on parks and recreation in cities and counties. The result has been not simply short-term employment but reliance by the larger fiscally troubled cities on CETA-paid employees for maintenance and operation of recreational facilities. In some cases, when untrained CETA employees replace permanent park and recreation workers, the quality of maintenance and operations suffers.[61]

The economic importance to the city of recreation is underscored in a study by the Rand Corporation, which concluded that policies affecting the quality of local amenities such as pollution control and the provision of cultural and recreational facilities will also affect migration patterns of households and the location decisions of some employers.[62] The study suggests that increasing the attractiveness of residential areas may be more alluring to new industry and commerce than simply reducing taxes.[63] Improved urban amenities are not only highly desirable for their own sake, to enhance the quality of life for city dwellers, but may also be essential to the economic survival of cities.

Urban Trees

Urban areas throughout the country have suffered increasingly from loss of trees and forests from disease, new construction, air pollution, vandalism, and the lack of forestry funds and technical information. As a result, these communities become less desirable places in which to live. Urban amenities diminish, and so do the benefits of trees in protecting urban watersheds, soils, and air quality and in conserving energy through temperature moderations.

The situation was recently illustrated by the results of a survey of 15 cities conducted by the Congressional Research Service.[64] Many of these cities spend from 50 to 75 percent of their urban tree budget on disease control and tree removal. Far more trees are lost than are being saved or planted. In Atlanta, 4,000 trees were lost in 1976 and only 1,000 were planted. In Houston 90 percent of the forestry program is devoted to tree removal and thinning caused by disease, and in St. Louis, which lost one-half its trees in the last 20 years, the problem is similar. Elsewhere throughout the country small communities lack the professional urban forestry departments and the expertise of large cities. Particularly in the East and Midwest tree losses have drastically changed the character and desirability of towns and villages, and funds are not available to reverse the trend.

The esthetic costs of such tree losses have been difficult if not impossible to estimate. But the value of urban trees as effective air pollution sinks or filters received significant support from a recent EPA research report, *Open Space as an Air Resource Management Measure.*[65] The study noted that plants and trees, particularly evergreens, filtered tons of dust and other submicroscopic pollutants such as lead and were able to absorb significant quantities of ozone and sulfur dioxide in urban areas. Parks, urban forest edges, in particular, and even street tree plantings reduced pollution levels; Central Park significantly dilutes sulphur dioxide in mid-New York City, and London's Hyde Park reduces smoke concentrations by over 25 percent.

The study concluded that diverse pollution-resistant plantings in parks, utility and transportation rights-of-way, and cemeteries could be used far more effectively than they are to reduce urban pollution while providing the environmental advantages as well.

Recognizing these facts, the Department of Agriculture planned a major national conference on urban forestry in November 1978. Its purpose was to identify and evaluate the research and knowledge available to urban policymakers on the physical, social, and economic values of urban trees.

PROTECTION OF SPECIAL AREAS

Changing patterns of urban development and growth in previously undeveloped areas has a pronounced effect on our environment, making efforts to preserve our cultural and natural resources increasingly important.

NATIONAL HERITAGE PROGRAM

Although the federal government has been involved in natural and historic preservation for some time, the efforts have not always been well-coordinated from a policy and program point of view. To help alleviate this problem, the President's Environmental Message of May 1977 directed the Secretary of Interior, Cecil D. Andrus, to develop a National Heritage Program to identify, select, and protect significant cultural and natural resources.

In January 1978, Secretary Andrus approved the concept of the National Heritage Program and the creation of the Heritage Conservation and Recreation Service within the Department of the Interior, which would adminster and coordinate the program and serve as a focal point for a broad range of federal conservation and recreation activities. To meet its responsibilities in cultural, natural, and recreational programs, the HCRS incorporates most of the functions of the former Bureau of Outdoor Recreation, which managed the Land and Water Conservation Fund, the Office of Archeology and Historic Preservation, and the Natural Landmarks Program, both formerly part of the National Park Service. Key elements of the National Heritage Program include:

- Expansion and maintenance of the National Register of Historic Places and establishment of a new National Register of Natural Areas—this new register will list areas which possess significant ecologic, geologic, scenic, and wildlands values that should be protected as elements of our natural heritage.
- A National Heritage Policy Act—if passed by the Congress, the Act would create a Council on Heritage Conservation, a reconstituted and expanded successor to the existing Advisory Council on Historic Preservation. Duties of the Council will be to advise the President and the Congress on policy matters involving historic preservation and natural area conservation, to represent the public interest in the resolution of conflicts that may arise between conservation goals and other federal programs and projects, and to provide an independent voice for heritage concerns at a high level of federal decisionmaking.
- The first comprehensive national inventory of potential heritage resources—the HCRS would develop a standard method for classification of natural heritage resources to help states to approach resource inventories systematically. The National Heritage Program is based on the concept that the key to successful heritage conservation is voluntary action by private individuals and organizations and by local and state governments supported by a responsive federal government.
- Technical assistance to state and local agencies on the formation of cultural and natural heritage programs—guidance of this kind is a major part of the HCRS National Heritage Program.

FLOODPLAINS AND WETLANDS

The federal government has begun a major effort to give wetlands and floodplains special attention. Two Executive orders issued by President Carter on May 24, 1977, prohibited federal agencies from needlessly damaging or destroying wetlands and floodplains.[66] If an agency proposes to conduct or support an action located in a wetland or floodplain, the orders require the head of the agency to make a written finding that there were no practicable alternatives to the site. Federal officials are required to practice sound land use management in these areas and to set an example for local government and private citizens.

The Executive orders were issued because of the continuing threat to the existence and quality of the nation's wetlands and floodplains. The U.S. Fish and Wildlife Service will not complete its definitive inventory of the nation's wetlands until the early 1980's, but estimates have placed the figure for the wetlands loss as high as 40 percent since the nation's birth.[67] And despite a $10 billion federal investment in flood control works since 1936, annual losses from floods now approach $3 billion annually, and damaging modifications of floodplain areas continue to increase as inexpensive land becomes scarcer in urban areas.

The important natural functions and beneficial values served by wetlands have been well-documented.[68] Wetlands are highly productive, providing food and habitat for fish and wildlife; they also provide natural flood control, protection of water quality, and recharge of aquifers. Executive Order 11990, "Protection of Wetlands," provides for the first time a comprehensive policy for wetlands protection for the entire federal executive branch.

The Congress previously had enacted more than a dozen laws which gave partial protection to wetland areas, the most important of which is Section 404 of the Federal Water Pollution Control Act.[69] This section requires a permit from the Corps of Engineers for the disposition of materials in waters of the United States. Inland and coastal wetlands throughout the country have, as a result, received strong federal protection. Amendments to the Act in 1977, however, exempted certain routine forestry and agricultural practices from the permit requirement. The Congress also exempted from the permit requirement federal projects, which will be primarily water projects, that are submitted to the Congress prior to specific authorization or appropriation requests and before any actual discharge. In these situations, the submission to the Congress must include an environmental impact statement containing information on the effects of the proposed discharge. To meet this requirement, the executive branch has established a policy not to submit authorization or appropriation requests to the Congress on projects subject to the exemption until the environmental impact statement process has been completed and EPA and the Corps of Engineers have rendered opinions on the projects' consistency with natural wetlands protection policies and criteria.

Executive Order 11988, "Floodplain Management," replaced the 1966 Executive Order 11296, "Flood Hazard Evaluation," which recognized that structural flood control measures alone were inadequate to stem rising flood losses. The 1966 order was followed by the establishment of flood insurance, disaster assistance and related federal programs, and some state and local floodplain management. The new Executive order adds an environmental perspective to the objective of achieving flood control. The order seeks to preserve the natural and beneficial values of floodplains—wildlife habitat, farm and forest, stable ecosystems, parks and recreation—as well as limiting flood losses and the direct threat of floods to human health and safety.

Both the wetlands and floodplains Executive orders require the heads of agencies to make a specific public finding if there is no practicable alternative to siting an action in the area; in addition, agencies must take all practicable measures to minimize any harm that may result from the action. The President directed agencies to involve the public in making decisions affecting floodplains and wetlands. The orders apply to actions which are approved, assisted, or regulated by federal agencies as well as to direct federal projects.

Rising waters harmlessly flood an urban park in Allentown, Pa., preventing high flood damage. The park provides recreation to more than 100,000 area residents. Urban center flood damage has been virtually eliminated.

GREENLINE PARKS

Urban sprawl and buckshot urbanization have put intense pressure on previously secure landscapes of national importance because of their scenic, recreational cultural, and ecological value. There are sizable areas in every state that have these special characteristics. Notable examples are the 1-million-acre Pine Barrens of New Jersey, the 200,000-acre Santa Monica Mountains northwest of Los Angeles, the 45-mile Chattahoochi River corridor near Atlanta, the Appalachian Greenway, the Potomac River shoreline, the Nantucket Sound islands, and the Jackson Hole area in Wyoming.

Unlike National Parks and Wilderness Areas, these "living landscapes" contain settlements where people both live and work. Because of their special values and their unprotected status, local and state governments and citizen groups have sought throughout the past decade to include many of these areas in the National Parks System. In the past, federal acquisition has shielded areas that were similarly intertwined with urban areas from development pressures. The Cuyahoga National Recreation Area near Cleveland, the Cape Cod National Seashore, Fire Island National Seashore near New York City, and the Golden Gate National Recreation Area near San Francisco are a few recent examples.

But most of the outstanding living landscapes now vulnerable to leapfrogging urbanization simply cannot be protected *as a whole* by the usual federal preservation and land acquisition policies. The areas are generally too large and federal funds far too limited for traditional protection through acquisition. Simply stated, at an average (conservative) figure of $2,000 per acre, acquisition of a mere 500,000 acres would cost $1 billion—$400,000 more than the entire Land and Water Conservation Fund for 1978. Moreover, many landscapes thrive and depend on agriculture or recreation, and the area's character and amenities are linked with these economic activities and the communities that have grown up in the areas. Under these circumstances federal acquisition and management are apt to be both inappropriate and prohibitively expensive.

The "greenline park" idea has evolved out of this situation. According to this concept an area of outstanding importance would be entirely delineated by a "greenline" and would be protected by an assembly of legal measures, of which acquisition would be just one relatively minor part.[70] Within the boundary a local-state or regional agency should seek to establish comprehensive protection through the acquisition of certain essential and natural or scenic areas including those that would not otherwise be protected. Protective measures would include "less than fee" acquisition techniques, such as the public purchase of easements or the rights of landowners to develop their property, and a variety of regulatory tools, such as critical area restrictions, zoning, and subdivision plans requiring dedication of parks, necessary roads, and other public services. The planning and management agency would submit a protection plan to the federal government. After federal approval, the agency would

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receive funds for essential acquisition and if necessary for management support of the entire "greenline park." The result would be protection of areas of outstanding national importance, public access and recreation opportunities in the area, and the continued economic vitality of the region.

The concept is not new. Precedents include the Adirondack Park in New York state. Of the Park's 6 million acres, less than 40 percent is owned by the public; the private land is regulated in a variety of ways by the Adirondack Park Agency. English National Parks are also primarily owned by private landowners—the famed Lake District National Park, home of William Wordsworth, is 25 percent owned by the quasipublic National Trust, but the entire area is strictly controlled to maintain its cultural, scenic, and recreational values.[71] The Wild and Scenic Rivers System also envisages mixed public and private ownership under overall protective plans and management.[72]

Recognizing the merits of local greenline park development and management and the practical reasons not to rely solely in the future on federal acquisition and management for all areas of outstanding natural and scenic importance, the Administration endorsed a new "greenline park" proposal for the protection of the Santa Monica mountains and its adjacent coasts. These mountains, a small part of the Pacific Coast Range, drop down to popular sandy beaches that extend some 37 miles along the Pacific Ocean. Within the mountains are narrow canyons, creeks, and inland valleys notable for richness of wildlife and scenic vistas. This vast green space, still largely undeveloped, provides fresh air and recreation opportunities to the Los Angeles area and to millions of tourists each year.

The Administration proposal is in contrast to proposed legislation that would establish a Santa Monica National Park and Seashore, comprising 150,000 acres of new and existing parkland and costing up to $300 million. The Administration approach would establish a much smaller 30,000-acre core area as the Santa Monica Mountains National Recreational Area. The core area would be bought at a federal cost of $125 million, and provision would be made for possible eventual state or local management of the recreation area. Surrounding the core area would be the 200,000-acre Santa Monica Preservation Zone. Within this zone, state and local governments would preserve open space, recreational, and other environmental values through regulatory and other legal techniques. Federal actions which might interfere with the preservation of this broader area would be restricted. Federal assistance would be available to state and local governments in this preservation effort.

The Santa Monica proposal represented a new partnership of federal, state, and local agencies that the Administration intends to apply in the future to other living landscapes of national concern.

THE COASTAL ZONE

Protection of the nation's 100,000 miles of shoreline through collaborative planning by federal, state, and local units of government is progressing as states complete their management programs under the Federal Coastal Zone Management Act.[73] However, legal challenges by the oil industry are testing many fundamental aspects of this pioneering land use law.

Management Programs

All 30 eligible states and four of five U.S. territories are continuing their voluntary participation in the federal Coastal Zone Management Program. Of these states, six, Washington, Oregon, California, Massachusetts, Rhode Island, and Wisconsin, had federal approval for their programs by June 30, 1978. Two programs for smaller segments had also been approved, one for the San Francisco Bay area (planned separately and approved earlier than the statewide program) and another for the Culebra area of Puerto Rico.

A strong incentive for states to complete their programs is the consistency requirement of the Coastal Zone Management Act. This key provision of the law requires federal agencies to make their activities consistent to the maximum extent practicable with state programs once they are approved by the Secretary of Commerce. Further, federal agencies may not grant permits to private parties for activities in the coastal zone unless the activities have been certified by the states as consistent with approved management programs. Federal consistency regulations are now in effect[74] after more than a year of discussions among federal agencies and public review of two sets of draft regulations.

Consistency and energy development are the central issues in a lawsuit against California's Coastal Zone Management Program brought by the American Petroleum Institute and the Western Oil and Gas Association.[75] California's Program permits local governments to make the comprehensive land use plans which will implement the state's Management Program; plans are subject to state approval and are to follow standards and procedures spelled out in the state Program. Until these plans are developed and approved, an interim program administered by the state will remain in effect.

The oil industry contends that local plans should have been completed and approved by the state before federal approval was given to California's Management Program. The Office of Coastal Zone Management of the National Oceanic and Atmospheric Administration argues that under its regulations state standards to be implemented by localities in California are specific, comprehensive, and enforceable. Pending a decision on whether California's Program meets the requirements of the law or whether approval should be rescinded and the Program sent back to NOAA for further action, the court permitted the Program to go into effect, which means that the state and localities may receive federal grants to carry out the

Program. However, the court enjoined application of the consistency provision until the case is decided on its merits.

The other principal issue in the suit is the oil industry's claim that California's plan does not give adequate consideration to the national interest in siting energy facilities, which the law expressly requires. NOAA's response is that California's Program does recognize that energy facilities may have to be sited in the coastal zone despite adverse impacts but that it requires that the public welfare must be considered in the siting decisions. California's Program includes detailed guidelines for coastal zone siting of specific energy facilities, such as refineries, electric powerplants, oil tanker facilities, oil and gas development facilities, and liquefied natural gas terminals. It also provides a process for energy facility planning which, NOAA argues, assures that the national interest will be considered.

The suit challenges California's Program on numerous other grounds, including a claim that the requirements of the National Environmental Policy Act were not satisfied because NOAA failed to include in its impact statement an evaluation of the possible impacts of the state's using the consistency provision to frustrate outer continental shelf development. This argument is characterized by NOAA as highly speculative, with no basis in the Program.

Lawsuits brought by American Petroleum Institute in Massachusetts and Wisconsin allege that these states too have failed to provide for the siting of energy facilities. More fundamentally, the suits attack the states' legal authority to adopt programs at all.[76] The industry contends that the states must have specific legislation authorizing coastal zone management programs. California has such a law, although the industry lawsuit there claimed that certain elements of the state's Program were not adopted legislatively and are therefore invalid.

NOAA's position is that states may use a network of existing laws plus administrative rules ("networking") as the basis for their programs, and indeed this is the plan in many coastal states with programs headed for early approval. Of the 33 states and territories in the CZM Program, 3 were able to rely entirely on existing legal authority. In 18, new legislative authority has been provided—either comprehensive coastal zone management laws, like California's, or explicit "networking" authority. In 10 others, action by the legislature is pending or anticipated.[77]

The Massachusetts program was also attacked from another quarter by the Natural Resources Defense Council. NRDC joined the defense in the oil industry suit but at the same time filed a cross-claim alleging that Massachusetts regulations which purport to bind state agencies to the program are not legally enforceable. NRDC argued, in a similar vein to the oil industry but to a different purpose, that the Massachusetts program does not specifically provide regulations for wetlands protection, water pollution control, ocean sanctuaries, and other environmental values. NRDC dropped its cross-claim on June 29, 1978, when Massachusetts agreed to a stipu-

lation that five sets of state regulations affecting coastal resources would be issued by certain agreed-upon dates. The stipulation also requires consultation with the state Office of Environmental Affairs before any major state-funded transportation projects are built in the coastal zone. And it requires Massachusetts to file a plan with NOAA for protection of resources within areas of special environmental concern or areas for preservation or restoration.[78]

Washington, which was the first state to gain federal approval for its Coastal Zone Management Program, has now become the first to ask for a major amendment to the Program. Governor Dixy Lee Ray has requested deletion of a "policy statement" by her predecessor, Governor Daniel J. Evans, which would preclude the siting of any major oil facility in Puget Sound anywhere east of Port Angeles. The situation is complicated by the fact that an amendment to the Marine Mammal Protection Act of 1972 declares the waters of Puget Sound a "national asset" and forbids the issuance of a federal permit or license for oil facilities east of Port Angeles (unless the oil to be handled is to be consumed in Washington only).[79]

The Office of Coastal Zone Management is considering whether the Washington policy statement is enforceable, how it relates to the Marine Mammal Act Amendment, and whether the impacts of deleting it would be compatible with the goals of the Coastal Zone Management Act.

The Coastal Energy Impact Program

In its second year, the Coastal Energy Impact Program continued at much the same level as the first, with $110 million available for credit assistance to communities needing new public services on account of coastal energy development, $17.7 million for formula grants, $3.5 million for planning grants, and $1.5 million for grants to protect the environment or improve recreation. Although 33 states and territories have been allocated funds under the Program, most so far have spent only small amounts, primarily for planning. The exception is Louisiana, which in fiscal year 1977 spent $5,460,000 in formula grants for road construction, water improvements, and other projects and received $10,830,000 in loans for projects such as hospital improvements.[80]

Pending outer continental shelf legislation is expected to make a major change in the formula grants program. Both House and Senate versions provide that eligible states could directly tap formula grants for funding community improvements instead of being obliged first to try for loans.[81]

Estuarine and Marine Sanctuaries

Estuaries and associated wetlands are given special protection by the Coastal Zone Management Act because of their biological, scenic, and recreational value. Five estuarine sanctuaries have so far been established under the joint federal-state program authorized by the

Act: Coos Bay, Oregon; Sapelo Island, Georgia; Old Woman Creek, Ohio; Maimanu, Hawaii; and Rookery Bay, Florida.

Among a score of other areas under consideration for sanctuary status are two, in Florida and California, for which state planning is well-advanced. Florida has applied for a federal grant to develop a management plan for a sanctuary near Appalachicola, a Gulf coast fishing port. The state has already purchased 28,000 acres of land; an additional 13,000 acres of land plus 129,000 acres of water bottom would complete the sanctuary. A major objective in managing the sanctuary will be to protect local fishing and thus preserve the social and economic character of the community.

California is at a similar stage of planning for its proposed Elkhorn Slough sanctuary. The state is planning the project in conjunction with the Interior Department's Fish and Wildlife Service. The proposal includes the land on one side of the Slough in the sanctuary, and it creates a fish and wildlife refuge on the other side.

Another federal program helps to preserve ocean areas of exceptional recreational, ecological, or esthetic value. Under the Federal Marine, Research and Sanctuaries Act of 1972,[82] the Secretary of Commerce may designate marine sanctuaries to be managed for protection of their unique character or vulnerable resources.

Two east coast ocean areas, the site of the wreck of the *U.S.S. Monitor* off North Carolina and the Key Largo coral reef off Florida, are already established as sanctuaries. In mid-1978 there were proposals for six other areas, one in the Gulf of Mexico off Texas and five in waters off California:

- The Flower Garden Banks in the Gulf of Mexico, the northernmost living coral reefs on the continental shelf of the United States
- Areas of the Santa Barbara Channel which support the world's largest and most diverse temperate water pinniped community, 18 rare or endangered species, and other highly productive biological communities
- The intensively used marine areas around San Diego which attract more than 1 million tourists each year and are habitat for large diverse marine mammal and seabird populations
- Monterey Bay, site of major breeding grounds for sea lions, harbor seals, and elephant seals; important habitat for the protected sea otter; and the richest marine flora concentrations on the west coast
- Tanner and Cortes Banks, where the coral *Allopora* (uncommon in U.S. waters) grows in unusual red and purple forms
- The ocean area surrounding Point Reyes and the Farallon Islands, which supports the largest seabird breeding colony in the contiguous United States, provides habitat for endangered species such as Brown Pelicans, and offers productive breeding and pupping grounds for California sea lions, elephant seals, Stellar sea lions, and harbor seals.

TRANSPORTATION

The impact of transportation on the shape, size, economic condition, and social character of human settlements is pervasive. Until the end of the 19th century, the relationships of various urban land uses were determined by walking distances, which created high density development at the center of cities and a mix of human activities that were dependent on each other for interaction and mutual support.[83] Public transit and suburban trains let people travel farther to outlying areas. Automobiles permitted even more decentralization. Los Angeles, for example, was first shaped by streetcar transit. Not until the 1950's did the many small municipalities that made up the city fill in the undeveloped areas.[84]

Most U.S. cities today reflect the primacy of automobile transportation.[85] However, a modest increase in transit ridership is evident in the 1970's, and transportation policy is beginning to address highway and transit systems in a more integrated way. Both federal and state policies are now concerned with the need to maintain highways that are already in use and to offer communities the choice of better public transit as well as transportation by private automobile.

HIGHWAYS

New highway construction has declined, not because of less reliance on the automobile but because the Interstate Highway System is nearly complete. The rate of increase in construction of new highways has been dropping since the 1960's. For the 3 decades from 1930 to 1960, the average annual increase in the total mileage of surfaced roads and streets was 3.7 percent. During the 1960's, the average annual increase fell to 1.4 percent, and after 1970 it slowed to 1 percent.[86] The emphasis is shifting from construction to maintenance. Although the nation's Interstate Highways are generally in good condition today and many are new, expensive maintenance programs will be needed to keep them safe and comfortable.[87]

The Interstate Highway System has been the most ambitious public works program in the history of the nation. Its impacts on urban and rural areas have been enormous. By mid-1978, 92 percent of the System was open to traffic, 3 percent was under construction, 4 percent was approved but not yet started, and only 1 percent (about 500 miles) was not yet approved.[88] The unapproved Interstate Highway segments have often been controversial for environmental reasons.[89]

The original justification for the Interstate System was to connect cities, states, and multistate regions.[90] This goal has been largely achieved, but to a large degree the system also serves intracity traffic. Fifty-three percent of all Interstate traffic is within metropolitan areas, and 17 percent of all urban transportation is on Interstate Highways.[91]

Some of the most controversial proposed segments of the Interstate System are those which would be used as commuter highways—

such as I-66 connecting the northern Virginia suburbs to Washington, D.C., and I-85 northest of Atlanta. For segments like these, final approval now often depends on the inclusion of transit benefits such as special rush hour bus and carpool lanes.

REVIEW OF HIGHWAY DECISIONS

The Department of Transportation's environmental review process considers the impacts of specific transportation projects on human settlements and helps to ensure that highway and transit projects are compatible with the surrounding environment. Many state and local transportation agencies are also responding to environmental concerns.[92] The project changes below are a few examples of modifications made for environmental reasons through cooperative effort of all parties concerned.

Projects Approved with Significant Improvements

State highway officials and environmental groups agreed late in 1977 that Interstate Highway funds could be used to build a parkway limited to two or three lanes in sensitive areas through Franconia Notch State Park in New Hampshire. An Interstate Highway was originally disapproved by former Secretary of Transportation John A. Volpe in 1970. After continuing controversy, the Congress passed special legislation in 1973 allowing use of Interstate Highway funds to build this section of I-93 as a parkway not meeting Interstate design standards. On November 18, 1977, the Governor of New Hampshire, the state highway and natural resources agencies, and environmental groups signed a Memorandum of Agreement on the basic design to be reviewed in the final EIS.

Agreement was reached on the 120-foot-long Elm Street Bridge in the Woodstock, Vermont, Historic District. The Bridge, dating from the mid-1800's, had been marked for early replacement under Vermont's bridge replacement program, which is supported by federal funds. Local citizens, civic leaders, and the State Historic Preservation Officer strongly objected to the proposed replacement, which would have been a 40-foot-wide concrete bridge. The Federal Highway Administration agreed to relax its minimum design standard and allow a 26-foot-wide replacement bridge that would incorporate some of the bridge's original structures. A Memorandum of Agreement signed in March 1978 outlines safe, visually compatible design measures. The Federal Highway Administration recognizes the importance of historic considerations in its bridge replacement program and supports legislation to allow federal funding for rehabilitation as well as replacement.

Early in 1978, DOT approved a 6.5-mile section of the Southeast Belt Route (I-215) just outside Salt Lake City. The project has been controversial for years because it runs through a residential area. To mitigate the noise generated by the highway, final plans

provide for several miles of depressed roadway and extensive noise barriers.[93]

Projects Withdrawn

A number of projects that had been challenged on environmental grounds or reevaluated by the local governments were recently withdrawn. The 1973 "Interstate Transfer" provision allows withdrawals from the Interstate System and substitution of other transportation projects.[94] For example, Illinois Governor James Thompson and Chicago Mayor Michael Bilandic submitted a joint request, approved in September 1977, to withdraw a 6.3-mile segment of I-494—the Crosstown Expressway in Chicago. The request freed $300 million in federal funds for the Franklin Street Subway, a substitute transit project, and $153 million for various urban highway improvements.

Colorado Governor Richard Lamm's request to withdraw I-470, a proposed circumferential highway near Denver, was approved in September 1977. The withdrawal made $180 million in federal funds available for substitute urban highway improvements.

In April 1977, the FHWA deleted the Three Sisters Bridge (I-266) and a connection to the bridge in Virginia from the Interstate System. The $43.5 million in federal funds made available by the transfer is earmarked primarily for construction of the Washington area subway system and one substitute bridge improvement project in the District of Columbia.

A Project Rejected

Secretary of Transportation Brock Adams informed Governor Ray Blanton of Tennessee in September 1977 that he could not approve federal assistance to construct Interstate-40 through Overton Park in Memphis because he was not convinced that there were no feasible and prudent alternatives to the taking of parkland.[95] The decision marked another milestone in years of controversy concerning construction of I-40, which has been strongly opposed by environmental groups.

UNUSED HIGHWAY LAND

Secretary Adams announced on June 27, 1978, that states which cancel proposed highways and plan to use the land for public projects will not have to pay back the original costs of acquiring the land. Acceptable public projects include parks, schools, public housing, and the like. If a state should sell the land, however, the federal government would be paid back a portion of the sale price, pro rata with its original contribution to buying the land. The Federal Highway Administration proposed regulations on August 7, 1978, to implement the new policy.

PARKING MANAGEMENT

An important strategy to improve transportation and air quality together is to control parking in downtown areas. The most effective parking controls are not on street parking, which often raises objections, especially from local businesses, but those on free or inexpensive parking subsidized by employers. It has been estimated that parking controls could lead to a 15–20 percent increase in transit ridership, provided that a transit alternative is available.[96]

The range of parking management strategies includes parking taxes, residential parking permits, regulation of parking charges, commercial rates in place of free or low-cost parking, restricted supply of parking spaces, and auto-free zones. The choice of a particular strategy needs careful study, but the policy of parking management appears to be generally effective.[97]

Fringe parking for commuters can discourage downtown parking and increase transit use. Secretary Adams announced on April 18, 1978, that the Department was initiating a new program of federal funding for states to lease fringe parking lots from shopping centers and other private owners. But routes will pass through the parking lots to provide convenient downtown transportation for commuters.

The new leasing arrangement will cost substantially less than special lots for commuter parking. In the past, federal funds were available only for purchasing land and building new parking lots. Federal funds can now also be used for passenger shelters, bicycle lockers, and lighting at the parking lots.

TRANSIT

The settlement patterns of the postwar years drastically undermined urban transit. At the same time that highways were being built to the suburbs, the flow of population out of inner city neighborhoods cut the use of public transit. Then service was reduced, making public transit less attractive, until most of the riders left (outside rush hour) were those with no choice—the young, the old, the poor, and the handicapped.

The decline of transit also reflects the migration from the older, denser cities of the Northeast to the less centralized towns of the South and West. Major transit-oriented cities like Boston, New York, and Philadelphia have lost both population and transit ridership in recent years.

During the 1960's the total number of transit passengers dropped 2.4 percent per year and from 1970 to 1974, 1.4 percent per year. Only in the last few years has transit use begun to recover slightly from a 30-year decline. Since 1974 it has edged upward, rising approximately 0.9 percent per year.[98]

Rail Transit

The National Mass Transportation Assistance Act of 1974[99] resulted from, and also stimulated, interest in rail transit.[100] Some 60

applications from cities for subways and aboveground rail systems have been submitted to the Urban Mass Transportation Administration since the law's enactment. Because the interest far exceeded congressional appropriations and to encourage more cost-effective decisions and more efficient transportation, UMTA requires an "alternatives analysis" with applications for rail transit funding. Cities must show that before they apply for a fixed guideway system, other less expensive methods were tried or considered.[101]

Bus Transit

After a careful comparison, many cities have discovered that their spreadout neighborhoods, businesses, and shopping areas make bus transit more practical than rail: A good bus system costs less, and routes can be adjusted to accommodate shifts in population or commerce.[102] Further, improvements to bus systems can be made more quickly than to rail systems, which take years to plan and build.

Since its inception in 1964, UMTA has provided federal financial aid to buy buses, maintain or upgrade vehicles in service, and build transit-related facilities. Since 1974 UMTA has also provided operating subsidies. During the last 14 years, UMTA has helped cities buy 32,220 buses (and related support) at a cost of about $2 billion.[103] Most of the buses were replacements; less than 5 percent were used to expand fleets. During fiscal year 1977, 132 urban areas used federal funds to purchase a total of 3,808 new buses at a cost of approximately $300 million.[104]

Federal assistance has provided a wide array of transportation options for urban and rural areas. For example, special use vehicles, such as buses specially equipped for the elderly and handicapped, have been funded under the grant program.

Transit and Land Use

As new public transit systems are built, the relationship between transit decisions and land use decisions affecting patterns of growth assumes new importance. Regional planning can link the two.[105] But comprehensive planning for transit, housing, and commercial development has not been very successful in this country. Only a few urban areas, such as Minneapolis-St. Paul, have regional governments with legal planning authority to carry out comprehensive development plans. One recent study indicates that effective urban land use policies can substantially increase mobility while conserving energy as well.[106] The potential is high in areas of new growth, such as the South and Southwest.

Some foreign cities, like Toronto and Montreal, limit commercial and residential high rise buildings to areas within walking distance of a transit station. In U.S. cities with new rail systems but without comprehensive planning, development is still likely to center around the transit station. As property values near transit stations rise, high density development is likely. Economic incentives spur development

similar to that which land use planning would have achieved, but without the benefits of comprehensive planning.

A 1977 report to the Department of Transportation studied the land use impacts of older rail transit systems in U.S. cities, new rail transit in Toronto, Montreal, and San Francisco, and other transit systems such as light rail and busways. The report concluded that recent transit improvements have been important inducements to higher density development near transit stations, but only when supported by demand for new office space and apartment development. In other words, the transit stations helped determine the location of new demand rather than generate them. The report notes that major transit improvements may not cause net gains in urban economic or population growth, but they can help attain other goals—such as mobility, air quality improvements, and safety.[107]

NEW FEDERAL TRANSPORTATION POLICY

Legislation

New highway and transit legislation[108] sent to the Congress by Secretary Adams in January 1978 represented a year's work by the Administration to integrate the highway and transit programs. Extensive hearings were held in 1977 and 1978 by the relevant Senate and House committees.[109]

The proposed legislation embraces three major goals—to improve transportation planning, to make funding more flexible, and to complete essential gaps in the Interstate System. The Administration also proposed increases in surface transportation funding, which in total would amount to more than $45 billion during the 4 fiscal years 1979–82.

The proposed legislation would consolidate highway and transit planning funds and program regulations. The need to improve transportation planning at the regional level has been apparent for several years.[110] In 1975 DOT began to require Governors to designate "metropolitan planning organizations" to serve as the forum for making transportation decisions in urban areas.[111] But most MPOs lack authority and financial independence to carry out their decisions.[112] The bill would give new support to the MPOs and encourage better regional transportation planning. DOT proposed to review and approve transportation plans for these areas and to make them consistent with national transportation, environmental, and economic goals. Planning funds could be used for highway or transit planning at the discretion of the metropolitan planning organization.

Flexible use of transportation funds[113] is the second major goal of the bill, which would peg the federal share at 80 percent for most highway and transit capital projects, rather than the current 80 percent for transit and 70 percent for non-Interstate highways. The Administration believes that the federal share should be the same for all surface transportation projects so that there would be no bias

toward highways or transit. The proposed bill would also combine rural transportation assistance—including for the first time operating funds—into a single program under state supervision. The "urban systems" program [114] enacted in 1973 would continue with its flexible highway and transit program.

The third major goal is to complete the essential intercity gaps of the Interstate System. Secretary Adams has said: "For the past twenty years, national policy has directed a large part of Federal financing for transportation toward construction of the Interstate Highway System. With most of that system now built and in use, the time has come to bring this landmark effort to a sound conclusion." [115]

The bill proposes a cutoff date of September 30, 1982, for completing the environmental impact statement process or requesting deletion of the segment from the system. Segments without impact statements or requests would simply be dropped. Approved segments would have to be under construction by September 30, 1986.

Under existing law, the Governor and the relevant local governments may withdraw nonessential segments and use an equivalent amount of funds on other highway or transit projects.[116] However, the federal share is reduced from 90 percent for Interstates to 80 percent for substitute transit projects and to 70 percent for substitute federal aid highway projects, although the total amount of federal aid remains the same. The proposed legislation calls for the federal share on all substitute improvements to be increased to a uniform 90 percent.

The Urban Policy Message

President Carter's urban initiatives included a proposal for $200 million for capital investments in intermodal urban transportation projects to complement urban revitalization.[117] The goal is to integrate public transportation and other public needs, such as housing and business development. The program would link existing modes of transportation with projects such as terminals for transfers between rail transit and buses. It would also support joint development of transit and commercial projects near transit stations. UMTA will be considering applications from cities during the coming year.

Good Design

Secretary Adams announced a new DOT policy on the use of design and the arts in transportation in September 1977. The Department intends to encourage the use of good design, architecture, and the arts in federally assisted transportation projects. Design quality is now considered when transportation environmental impact statements are reviewed, and federal funds are available for incorporating good design into transportation systems.

CALIFORNIA'S NEW URBAN TRANSPORTATION POLICIES

California, the state that is famous for its freeways, is considering major changes in urban transportation policy which would deemphasize new freeways and give a higher priority to maintenance of existing ones and to public transportation.[118]

California's Office of Planning and Research set these priorities for funding highways and other transportation projects in urban areas:

- Maintenance and rehabilitation of existing highways
- Support for public transportation
- Reduced dependence on individual auto use
- Increased efficiency of existing highways
- Completion of gaps in the existing freeway system.

Serving the long-term needs of existing urban and suburban areas would come first. Second priority would be serving new development, but with preference given to providing service through public transportation. The state legislature opposed some of the proposed changes, but it appears that the state's urban transportation policy is following the same approach as the federal legislation proposed by DOT.

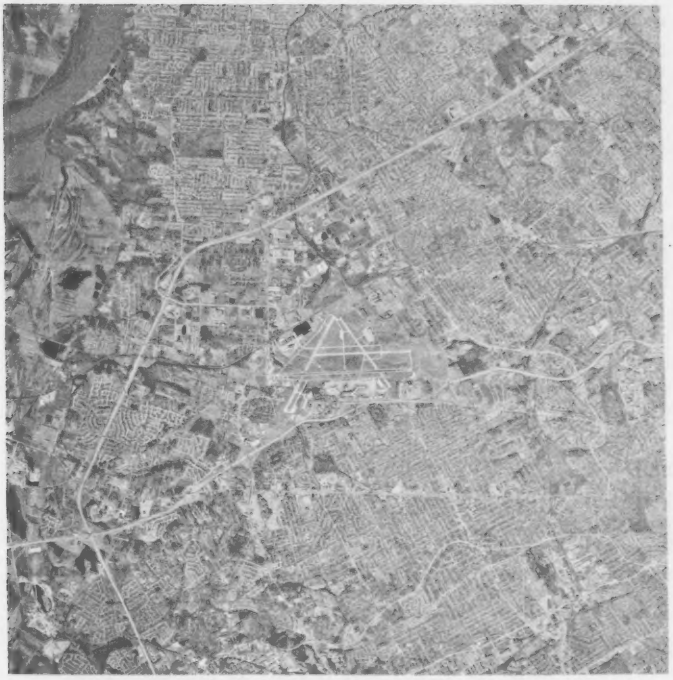
California has also worked toward easing current restrictions on federal and state funds that restrict their use to specific types of expenditures, such as construction versus operation and maintenance.

AIRPORTS

Airport Development

Major expansions of existing airports or new regional or local airports are influenced by and, in turn, influence settlement patterns and industrial growth. The federal government provides planning and construction funds to local authorities that own and operate airports. Little need for major new airports is anticipated, however.[119] A new airport at Palmdale to serve the Los Angeles region may be the only major airport to open in the next 10 years. Fifty-three small general aviation airports are planned to relieve major airports at congested hubs of some general aviation traffic. Most future development at major airports will be for safety, better productivity, and greater airport capacity to follow changes in demand as population shifts.[120]

The only recent proposal for a new regional airport was for the St. Louis area. But on March 30, 1977, Secretary Adams stopped federal funding for acquisition of land for the new airport site (nearby at Columbia-Waterloo, Illinois). After reviewing a decision paper by former Secretary Coleman supporting acquisition of the site [121] and additional data submitted by government officials of Missouri and Illinois, Secretary Adams concluded that it would be premature to continue federal funding because the need for the



Criticized as being too remote when it opened in the 1920's, the Lambert-St. Louis airport is now surrounded by urban growth—with no noise buffer zones and no possibility of providing them.

airport was uncertain and local opposition to the Illinois site was significant. Although noise impacts are substantial at the existing Lambert International Airport in St. Louis, Secretary Adams concluded that the communities around Lambert still preferred keeping the airport where it is.

The Federal Aviation Administration provides extensive guidance to airport operators and the public on ways to reduce noise and achieve compatible land uses around airports.[122] The FAA includes special conditions in grant agreements for airport projects to meet these objectives. For example, the grant agreement for a runway extension at Kalamazoo Municipal Airport provides that "the City of Kalamazoo shall in consultation with users . . . develop appropriate restrictions on jet operations at night and procedures for preferential runway use at the Kalamazoo Municipal Airport."

Nonconstruction Alternatives

In 1976, at the request of CEQ, the FAA initiated a review of nonconstruction alternatives that could be used to increase airport

capacity. The review was suggested to complement DOT policies of promoting more efficient use of existing transportation facilities and to ensure that nonconstruction alternatives such as flight rescheduling, variable landing fees,[123] and use of reliever airports receive adequate consideration in airport EISs.[124] Operational changes at airports can also save energy.[125]

Nonconstruction alternatives offer several advantages. New runways, for example, extend noise into new areas bordering airports. If alternatives are found, the extension of noise is limited, and, furthermore, the funds saved can be used to buy buffer zones in the high noise areas around the airport.

Nonconstruction alternatives also make it easier to achieve compatible land use. For example, to prevent further disruption of wetlands, Kennedy International Airport used pricing and similar methods to avoid building a new runway which would have harmed the environment of Jamaica Bay.[126]

The FAA has agreed with CEQ to consider nonconstruction alternatives in EISs for airport projects, including current expansion proposals for Cleveland and Raleigh-Durham. The FAA is preparing a new draft EIS for the Raleigh-Durham airport, which will include more information and analysis on nonconstruction alternatives.

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CHAPTER 6

NATURAL RESOURCES

AGRICULTURE

AGRICULTURAL LAND TRENDS

Historically, urban centers and farming regions have grown and prospered together. Cities typically developed along major land and water transportation routes, which often lay on the flat, fertile soils of coastal or river plains in the heart of prime farmland. Trade between urban centers and farms, traditionally essential to both economies, strengthened the connection. However, cities and farms are losing their traditional ties to one another. Cities now consume food and agricultural goods from an entire continent (and abroad), and modern farms may obtain their machinery, tools, fertilizer, and seeds from equally distant sources. As urban built-up areas expand, adjacent rural lands, often currently or recently farmed, come under intense development pressure; prospective shortrun economic gains to current owners from development weaken economic incentives to continue agricultural production.[1]

Prime Farmland

There is no universally accepted definition of prime farmland. Some definitions are wholly local, related to specific lists of crops, whereas others attempt a more general nationwide application. The Soil Conservation Service has proposed a definition which combines nine desirable characteristics, including moisture, temperature, humidity, air, drainage, and slope aspect.

A farmland inventory based on this definition is underway, but a soil survey of the 1,200 high priority counties is not scheduled for completion until 1981. Therefore, for purposes of this discussion, prime land will be determined by the land capability classification system and thus will include all Class I, more than 80 percent of Class II, and less than one-third of Class III soils as defined by the Soil Conservation Service.

Prime farmlands have been the most efficient, energy-conserving, environmentally stable lands available for meeting food needs. Their importance increases as doubts arise that the great growth in productivity of U.S. farms over the past quarter century can be sus-

tained. Among the reasons are increased costs of energy, fertilizer, pesticides and farm machinery; decreasing effectiveness of pesticides; limited availability of water; and biological ceilings (decreases in the rate of growth of production per acre). As increases in productivity per acre level off, it becomes increasingly important to preserve the lands that are best able to meet demands for food and fiber, both domestic and export, with the least inputs of energy and materials.

In 1977, U.S. farms not only fed our own population but also exported 50 percent of the wheat that they produced, 68 percent of the rice, 50 percent of the soybeans (including bean meal), 28 percent of the grain sorghum, and 28 percent of the corn. These exports were worth $23.7 billion, compared with total 1977 exports of $120 billion and imports of $146 billion. Although the United States produces only about one-fifth of the world's wheat and feed grains, exports account for 52 percent of the wheat and feed grains traded on the world market.[2]

Yet the evidence is that the soils best able to produce these crops are being turned to other uses at disproportionate rates. Current (1977) U.S. cropland amounts to 400.0 million acres, of which 250 million are prime lands. Between 1967 and 1975,[3] 24.3 million acres were converted to urban and built-up areas and to water uses; 8 million or 34 percent of this total was prime land, and 5.5 million acres came from crop production. Because prime land is believed to make up approximately 25 percent of the nation's privately held land, it appears that prime land is being withdrawn from food and fiber production at a disproportionate rate. The national loss of prime farmland is currently estimated at about 1 million acres per year, a little over 4 square miles *per day*. Offsetting a total cropland loss of 79.2 million acres during this period was the addition of 48.7 million acres, mostly derived from pasture and rangeland. However, as noted below, the quantity of reserves is not great, and the economic feasibility of future conversions is doubtful.

Loss of farmland of whatever class has environmental effects beyond the loss of crop-producing capacity. All open lands, including farmlands, help maintain local water supplies by absorbing precipitation and transferring it to the ground water system. Open lands protect the hydrologic integrity of watersheds by controlling stormwater runoff and sediment damage, and they protect aquifer recharge areas and serve as buffers for water supply and other natural areas.

Currently, well over one-half the acres removed from agricultural uses are subdivided or put to residential use. In the Northeast, the figure is closer to two-thirds. Another 10 percent or so are used for commercial and industrial development (the figure approaches 20 percent in the Northeast and Appalachian states).[4] Clearly there is significant pressure for conversion to built-up development. The remarkable change of the last decade, with the highest rate of U.S. population growth now occurring in rural and semi-rural

Land values have increased so much that some farmers cannot afford to pay taxes based on the potential developed land value. Above, rich peat farmland was converted to an extension of a New Jersey highway. Below, real estate development replaces a fine alfalfa field.

areas for the first time in our history, may create development pressure on farmland in new areas. (See the discussion in Chapter 5 on changing population trends.)

Pressures to convert good farmland to water uses appear much less intense. More than one-half the land inundated between 1967 and 1975 was marginal or unsuitable for crops, and only 9 percent was former cropland.[5] Indeed, if this marginal land is returned to use as wetlands, as has occurred in the Southeast, there may be important environmental gains. If sites for reservoirs, ponds, and water

retention structures are selected carefully, they need not have a serious impact on food and fiber production and may even become extremely productive of fish and wildlife.

Regionally, losses of prime farmland are becoming acute in the Pacific and Northeast; the Appalachian and Great Lakes regions are also under heavy pressure.[6] The loss of this diverse geographical base may become increasingly important because agricultural production is very sensitive to local or regional weather conditions and pests. The maintenance of diverse growing areas ensures that a local condition will not adversely affect national markets.

Conversion to Cropland

What are the possibilities of adding new land for crop production to make up for losses of good land? Based on 1974 price-cost relationships (a year very favorable to agriculture), 111 million acres were judged to have high or medium potential for conversion to cropland as of 1975. However, only about 24 million acres were prime land free of serious development problems (such as potential erosion or flooding) and required either no conversion from other uses or conversion only by the individual farmer.[7] Only another 11 million nonprime acres were similarly available. Since 1974, price-cost relationships have worsened for agriculture, which makes it less economically feasible to convert land to farm use. Figure 6–1 shows by region land with a high, medium, low, and zero potential for conversion to cropland based on the 1974 price-cost data. Note the relative scarcity of high and medium reserves in the regions which are losing prime farmland most rapidly, the Northeast and Pacific especially. Here reserves are equal to or less than the amount of prime land which, at present rates of loss, will be converted to other uses within 10 years.

Government Action and its Effects

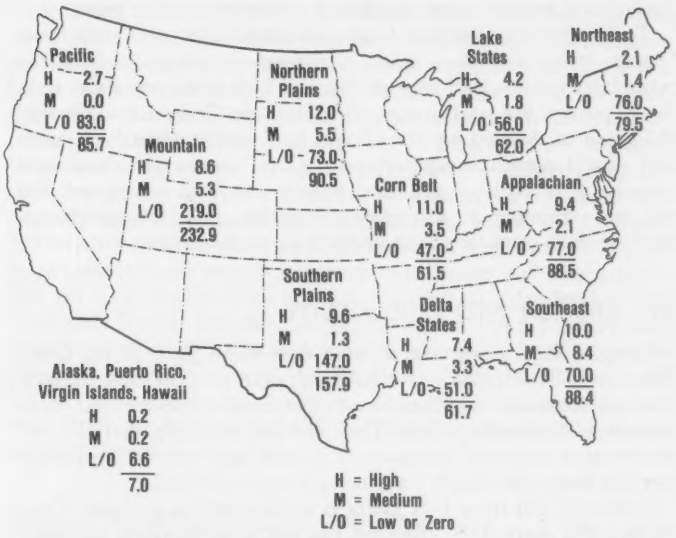
Federal, state, and local governments are becoming aware of how their actions may affect prime land and what they can do to protect it. Although federal activities themselves rarely directly use or convert large areas of prime land, federally funded projects and loan programs may exert powerful adverse secondary effects. For example, a regional trunk sewer line can be built with little, if any, permanent conversion of prime land. However, the existence of the line will be a key factor in determining regional growth patterns. If the line is built through an agricultural valley, urban development and loss of prime land are virtually guaranteed. Additionally, federal taxes, especially capital gains and estate taxes, may significantly influence the decisions of owners of prime land or their heirs to hold or sell their lands.

State and local governments have a variety of options to explore in their efforts to preserve prime farmlands. No single technique is likely to be entirely effective; each locality will need to find the

Figure 6-1

Potential for Conversion of Land to Cropland by Farm Production Region

(million acres)



Source: U.S. Department of Agriculture Soil Conservation Service, *Potential Cropland Study.* Bull. No. 578.

appropriate mix for its particular needs. Tax policy alone, for example, may not work. In *Untaxing Open Space*,[8] a study for the Council on Environmental Quality, it was found that differential tax assessment by itself is an expensive, frequently ineffective tool for preserving prime farmlands; a farmer's decision about whether to sell his land is more complex than the single issue of tax burden.

A variety of "less than fee" acquisition techniques have been used to protect agricultural resources. New Jersey established a Farmland Demonstration Project to maintain agricultural lands and open space on the urban fringe by purchasing landowners' rights to develop their farms. The program is voluntary. At average prices of $2,900 per acre, the first $5 million project appropriation may preserve less than 2,000 acres. A similar voluntary program begun by Suffolk County, Long Island, also seeks to protect its best farmland from urban sprawl by the purchase of development easements. The cost of such acquisition programs may, however, be a serious bar to their general application.

Agricultural zoning is another important technique. The Minneapolis-St. Paul Metropolitan Council, for example, has developed a zoning system to protect agricultural, rural, and recreational land

from hasty urbanization and to protect other agricultural land for continued farming activity. Adoption of agricultural zoning by one town in the area stimulated renewed investment by farmers who gained confidence in the local government's plans to maintain a stable agricultural region and supporting infrastructure. Agricultural districting programs in California, New York, Virginia, and New Jersey have recently been established to achieve similar goals.

To be effective, programs to save farmland must deal with many factors—rising real estate taxes, burdensome estate and inheritance taxes, incompatible land uses nearby, and high bids from those seeking to convert the land to nonagricultural use. States have a special obligation to develop an agricultural land policy, identifying lands that should remain in agricultural use and arming state and local agencies with the legal and fiscal tools to carry out a program that will make farming an attractive occupation. The federal government needs to consider ways to help states in this effort.

SOIL EROSION AND PRODUCTIVITY

Drought, high winds, and blowing dust swept parts of the Great Plains in 1977, bringing severe hardship, even ruin, to some farmers. The environmental significance of dust storms goes beyond their immediate distressing effects. They are also evidence that the soil conservation measures necessary to sustain agricultural production over the long term simply have not yet been achieved.[9]

Erosion of soil from U.S. farms is a longstanding problem. Over the last 200 years, U.S. cropland has lost approximately one-third of its topsoil. Since 1935, about 100 million acres have been degraded to the point where they cannot be cultivated; on another 100 million acres, more than 50 percent of the topsoil has been lost.[10]

A national survey of 4,300 counties conducted by the Department of Agriculture in 1967 revealed that erosion was the dominant problem on about one-half of U.S. crop, pasture, range, and forest lands; shallowness, stoniness, salinity, and drought were the major problems on about one-fourth and excess water on nearly one-fifth. Conservation measures or improvements were deemed necessary on 64 percent of the cropland, 67 percent of the pasture and rangeland, and 62 percent of the forest land.[11] The 1974 agriculture inventory of conservation needs confirmed the need for additional soil protection measures on about two-thirds of U.S. cropland and pasture.[12] In 1977, the General Accounting Office reviewed federal soil conservation programs and found that of 283 randomly selected farms, 84 percent had soil losses great enough to threaten long-term crop production.[13]

The dominant form of U.S. soil loss is sediment carried off by water. Some 4 billion tons of sediment per year are delivered to the waterways of the 48 contiguous states. Wind erosion accounts for another 1 billion tons per year. Three-fourths of the nation's waterborne sediment comes from agricultural lands.[14] About 1 billion tons

ends up in the ocean; the remainder settles in reservoirs, rivers, and lakes, shortening their useful life. Additionally, sediment often carries with it fertilizers, pesticides, and other byproducts of modern farming which degrade the receiving bodies of water.

The General Accounting Office review of current federal conservation programs criticized the efforts as ineffective despite the $15 billion spent since the 1930's. Soil losses from farms that participated were in general not less than those that did not; much money and staff time were spent for practices and programs which achieved little long-term success in curbing erosion. The Department of Agriculture is considering possible improvements in its programs.

There are possibilities for the control of erosion in the areawide programs for the control of nonpoint (indirect) pollution which are administered by the Environmental Protection Agency under the Federal Water Pollution Control Act Amendments of 1972. Section 208 requires states or planning districts to analyze the extent of nonpoint pollution and propose programs to minimize it.[15] The nation's 300 soil conservation districts might be used to help develop and implement Section 208 plans to control erosion from croplands and farm woodlots. Such a scheme is under consideration by EPA, and in general it seems desirable to integrate Section 208 planning with the USDA soil conservation programs. Thus water quality programs can effectively help to preserve the useful productive life of the nation's farmlands.

AGRICULTURAL SET–ASIDE PROGRAM

The Food and Agriculture Act of 1977 [16] makes it possible to tie conservation of the land and environmental benefits to the agricultural price support program. The set-aside acreage program, which takes cropland out of production for a growing season, has long been used as part of short-term federal efforts to support domestic farm prices. Under the 1977 Act, participating farmers must devote the set-aside acreage to conservation uses that will protect it from weeds and from wind and water erosion or else devote it to wildlife habitat and food plots. Commodities covered under the program include wheat, feed grains, cotton, rice, peanuts, and soybeans.[17]

The prospects for the new program are uncertain, however. A preliminary survey suggests that the participation rate may be one-half or less of the eligible farms.[18] It is doubtful that the minimum price guarantees and disaster insurance offered under the Act to take cropland out of production will achieve this purpose and raise prices to levels roughly equivalent to production costs. Nor does it appear likely that much of the marginal acreage recently brought into production, in response to high prices and the Ford Administration's 1975 call for greatly expanded production,[19] will be set aside for soil protection or wildlife use. These marginal lands are, in general, highly susceptible to erosion when they are tilled. Their

use as cropland may also cause more erosion, degradation of water quality, and loss of the land for more suitable uses, such as range, timber, or wildlife habitat. Participation in the set-aside program is not a prerequisite to receiving disaster aid—even if the farmer's failure to undertake conservation measures aggravated the extent of loss or damage.

Tying the crop set-aside programs to the USDA conservation cost-sharing programs and the EPA nonpoint pollution control programs could greatly benefit all these efforts. Each program preserves farmland and improves water quality. A comprehensive farmland program must consider both incentives and regulatory mechanisms for taking marginal lands out of production and thereby decreasing high rates of erosion.

INTEGRATED PEST MANAGEMENT

Until about 3 decades ago, crop rotations, pest-resisting crop varieties, cultivation, and natural forces such as biological control and weather were the first line of defense against pests. DDT and other synthetic organic pesticides introduced after World War II offered quicker, surer, and cheaper control of insects, plant disease organisms, weeds, and other pests. In fact, for a time these new chemicals appeared to be the ultimate control weapon.

Farmers became dependent on such herbicides as 2,4-D to control weeds previously taken out by "hoe hands" and mechanical cultivators.[20] Insecticides such as DDT were broadly toxic and persistent and could protect against whole complexes of insect pests all season long.[21] These and other post-World War II pesticides were initially so cheap that many farmers started applying them preventively even when the pests were present at less than damaging levels.

The new pesticides were equally impressive against public health pests. DDT, for example, rid entire nations of serious medical insect pests, such as malaria mosquitoes—at least temporarily.[22]

One-third to one-half of the world's chemical pesticide use is in the United States.[23] U.S. production of synthetic organic pesticides increased from about 200,000 pounds in 1950 to an estimated 1.6 billion pounds in 1976. Agriculture is the largest consumer of pesticides in this country; U.S. farmers used an estimated 660 million pounds (active ingredients) of pesticides on crops and livestock in 1976.[24] From 1971 to 1976 agricultural use rose approximately 38 percent, with herbicides applied to cropland showing the greatest increase.

Homeowners, businesses, and governments in urban areas also consume substantial amounts of pesticides. According to one study, suburban lawns and gardens receive the heaviest doses of pesticides per acre of any land area in the United States.[25]

Chemical pesticides have played and will continue to play an important role in agriculture, forestry, public health, and other sec-

tors. However, the inherent drawbacks of depending on chemical pesticides as the primary line of defense against pests are increasingly apparent. In fact, many pest control scientists question whether current chemical control technology is adequate to safeguard against serious pest ravages of the future.[26] Heavy use of chemicals has introduced problems of pesticide resistance, destruction of natural enemies, outbreaks of secondary pests, reductions of pollinators and other beneficial species, environmental contamination, and some human health hazards. Of these, one of the most serious and best documented is pest resistance, which makes chemical controls ineffective.

Pest Resistance

Worldwide, in 1975, 305 species of insects, mites, and ticks were known to possess genetic strains resistant to one or more chemical pesticides; another 50 species were suspect.[27] Of the pest species with confirmed or suspected resistant strains, 139 adversely affect human beings or livestock; 225 were important to agriculture (including pests that attack forests and stored products).

The resistant group includes some of the world's most damaging insect pests. Programs for malaria control are seriously jeopardized in Central America and Indonesia because malaria-transmitting mosquitoes are no longer susceptible to DDT and some other previously effective insecticides.[28]

Resistance in agricultural pests has caused some economically crippling effects. In the late 1960's, after an 8-year exposure, the tobacco budworm (*Heliothis virescens*) in Texas and northern Mexico suddenly became extremely resistant to methyl parathion. This cotton pest could no longer be economically controlled with insecticides. So severe was the damage in northern Mexico that the entire cotton industry collapsed. The region had been almost totally dependent on cotton; the collapse forced the migration of many farmworkers and disrupted the economic and social structure of the area's small villages.[29]

Another striking example of resistance is in the major agricultural state of California, where 75 percent of the state's most serious crop insect and mite pests have developed genetic resistance to at least one insecticide, and some are resistant to two or more insecticides.[30]

It was once thought that insecticide resistance to one type of chemical could be remedied by switching to a different class of chemicals. Experience has shown, however, that some insect pests develop resistance not only to closely related insecticides of one chemical class but even to insecticides of different chemical classes. For example, the tobacco budworm cotton pest became resistant to organophosphorous insecticides, some organochlorine insecticides, and one carbamate insecticide. Switching insecticides may therefore offer only a temporary reprieve in the fight against genetic resistance.[31]

The most serious problems of genetic resistance have been encountered in insects, mites, ticks, plant diseases, and rodents.[32] So far most weed control scientists do not view weed resistance as a serious threat. Nevertheless, weed strains that are relatively resistant to various herbicides have been identified.[33] A recent committee of the National Academy of Sciences concluded: "[W]e believe that the potential for resistance to herbicides by weeds has been underestimated and recommend that weed scientists maintain a careful watch for resistance development." [34]

Other Problems of Chemical Pesticides

A serious drawback to heavy use of some chemical pesticides is their adverse effect on nontarget species, particularly on the natural enemies of insects and mites. Natural enemies, if not disturbed by external factors, keep many species of potential insect and mite pests below economically damaging levels. The potential number of insect and mite pests in a crop may be high, but because they have effective natural enemies, they remain innocuous—so long as their enemies are not adversely affected. To succeed in the long run, pest management must control the relatively few key pests without upsetting the natural control of the vast majority of potential pests.[35]

Chemical pesticides have been widely dispersed in the environment, contaminating most of our aquatic and terrestrial ecosystems to some degree. Residues of persistent insecticides in heavily treated agricultural areas have damaged raptorial birds and important sport fisheries.[36] The same is true of pesticide use in cities and suburbs. Streams passing through urban areas may be more heavily contaminated with these chemicals than streams in farm belts.[37]

Acute poisoning of farmworkers, pesticide applicators, and others who come into direct contact with these toxic chemicals is another significant problem. Perhaps even more worrying are the potential problems of cancer, birth defects, and nerve disorders that may have their origin in low-level, long-term exposure to certain pesticides.

Evidence is accumulating that pesticides alone are unlikely to offer lasting protection either to public health or to agricultural production. Despite the vast growth in synthetic pesticides over the past 30 years, annual losses in all categories of pests, as a percentage of total potential crops, appear not to have declined. From the 1940's through the mid-seventies, losses caused by pests were about one-third of potential production, as shown in Table 6–1. There may have been a modest decline in the proportion of crop losses to weeds, but relative losses to insects appear to have increased. Crop yields rose during the 30-year period, but not nearly to the same degree as the use of pesticides (and other inputs such as chemical fertilizers).

The IPM Alternative

A promising alternative to the use of pesticides for the control of pests is the concept of integrated pest management. IPM uses

Table 6-1

Annual Pest Losses in Agricultural Crops 1904–1974

(billion dollars)

Time	Insects		Diseases		Weeds		Total loss		Potential production
	Value	Percentage	Value	Percentage	Value	Percentage	Value	Percentage	Value
1974	7.2	13	6.6	12	4.4	8	18.2	33	55
1951–60	3.8	12.9	3.6	12.2	2.5	8.5	9.9	33.6	29.5
1942–51	1.9	7.1	2.8	10.5	3.7	13.8	8.4	31.4	26.7
1910–35	0.6	10.5	NA	NA	NA	NA	NA	NA	5.7
1904	0.4	9.8	NA	NA	NA	NA	NA	NA	4.1

NA = Not available

Source: D. Pimentel, "Socioeconomic and Legal Aspects of Pest Control," in E.H. Smith and D. Pimentel (eds.), *Pest Control Strategies* (New York: Academic Press, 1978), p. 57.

all suitable techniques and information to reduce pest populations to tolerable levels, which adequately protect humans, domestic animals, and the environment. IPM strives for maximum use of natural controls over pest populations, including diseases, predators, parasites, and the weather, and enhances these natural elements with techniques such as soil tillage, crop rotations, and pest-resistant crop and livestock varieties.

Chemical pesticides are used as a part of IPM, but they are applied judiciously, only as required to keep the target pest from exceeding population levels determined to be intolerable. Such determinations rest on accurate assessments of the pest's damage potential and the ecological, sociological, and economic costs of the control measures.

Many recent reports agree that IPM holds great promise for cost-effective, environmentally sound pest control in agriculture, forestry, urban areas, and public health. A number of projects, many under the sponsorship of the Department of Agriculture and the land grant universities, illustrate the potential. Some have demonstrated that IPM can significantly reduce pesticide consumption for agricultural crops (and sometimes also reduce the use of fertilizer and irrigation) with no sacrifice in crop yield or quality.

IPM in Agriculture In Texas an integrated system of cotton production based on new, early maturing varieties has demonstrated that cotton can be produced with 50–75 percent less insecticide, 80 percent less fertilizer, and 50 percent less irrigation water than conventional varieties of cotton grown with high energy agriculture. In fact, yields have risen, with an increase in profits to farmers of more than $100 per acre.[38] The only extra burden to farmers is to check the crop carefully and regularly for pest insects, so that insecticides are used only when strictly necessary.

A University of Arkansas project has demonstrated integrated pest management for cotton in a 50 square mile area for the past

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3 years. Participating farmers—virtually all the farmers in the area—reduced the number of insecticide applications from an average of 10 per year to 2 while maintaining the same yields. The project emphasized giving farmers the technical assistance and trained field scouts necessary to implement the technology.[39]

Cotton farmers in Texas, Arkansas, and other states have recently suffered devastating losses from the tobacco budworm, bollworm (*Heliothis zea*), and certain armyworms (*Spodoptera* spp.). Even after pesticide applications costing $100 per acre or more, damage was still heavy, with disastrous economic consequences.[40] The success of IPM projects in Texas and Arkansas suggests that alternatives to still heavier use of chemicals (even reinstatement of DDT) are feasible and can be profitable.

In Washington, New York, and Pennsylvania, where more than 70 percent of the U.S. apple crop is grown and pesticide use has been high, integrated pest management programs are being rapidly established.[41]

Washington programs have cut pesticide use in half. Other programs only recently begun in the Midwest and the East have reduced use by 20–30 percent.[42]

Although integrated pest management draws from many of the nonchemical techniques and principles developed and used before the era of modern pesticides, it obviously does not mean a return to the hoe and the mule and the times when boys spent their summer picking beetles off potato plants for a penny a jar. The method and

An essential part of integrated pest management technology is to provide farmers with data, such as these trained field scouts provide by regularly checking a field.

materials of integrated pest management are a sophisticated application of ecological principles to achieve economical, environmentally sound pest control.

IPM in Other Sectors IPM projects in other sectors, although generally behind those in agriculture, are already yielding impressive results. A joint program of the U.S. Department of Agriculture, state agencies, and private forestry groups is concentrating on three of the worst forest insect pests—the gypsy moth, the Douglas fir tussock moth, and the southern pine beetle. Encouraging results using alternative methods such as viruses and bacteria that infect these pests have been reported.[43]

In the California cities of Berkeley, San Jose, Palo Alto, Modesto, and Davis, an IPM program has significantly reduced insecticide use on city-owned shade trees. Before the program was begun, approximately 16 percent of the 462,000 trees in the five cities were treated with chemical insecticides. Under the IPM program, chemical insecticides were used on only 0.08 percent of the trees; another 1 percent were treated with the insect disease agent *Bacillus thuringiensis*. The insect pests were effectively managed at this sharply reduced level of chemical treatment, and at the same time concerns about pesticide pollution lessened.[44]

The University of California, together with state control agencies, has developed an IPM program for mosquitoes that includes use of natural enemies (chiefly the mosquitofish *Gambusia* sp.) and selective insecticides. Control by manipulation of mosquito genetics has also been explored. The result was that in 1976 California used 63,000 pounds of chemical insecticide for mosquito control, compared to 615,000 pounds in 1962, the peak year of application.[45]

The effects described above give a glimpse of how integrated pest management can be employed effectively. Increasing use of these techniques is likely in the next few years. However, integrated pest management, especially management which emphasizes reduced pesticide use, is not a panacea and in fact may not always be the preferred approach. For instance, fungicide treatment for seed provides a low-cost protection for which there is no known alternative. Another example is early use of pesticides against serious foreign pests. To prevent the establishment and spread of these pests, detecting them when they are newly introduced and populations are low is crucial; vigorous use of chemical pesticides may succeed in eliminating them at this stage.

Even in cases in which integrated pest management is effective and economical, there may still be serious barriers to its use. Research, education, and demonstration projects will be required before the benefits of IPM are fully realized.

CEQ Review of IPM At President Carter's direction in his 1977 Environmental Message, CEQ is preparing a comprehensive review of IPM: the evolution of modern pest control technology and the use and limitations of chemical pesticides, the control techniques of integrated pest management, the state of the art in specific

sectors (e.g., agriculture, urban areas, public health), the barriers to more widespread use of IPM, and the federal role.

WATER RESOURCES

POLICY REFORM

The Administration's comprehensive water resources policy announced by President Carter on June 6, 1978, places a new national emphasis on water conservation, gives increased attention to the environmental concerns related to water projects, improves the planning and evaluation of federal water programs, and enhances federal-state cooperation in water resources management.[46]

The new policy, contained in a Water Policy Message to the Congress, was the result of a year-long review initiated by the President in his 1977 Environmental Message. The review was carried out by the Interior Department, the Council on Environmental Quality, and the Office of Management and Budget under the chairmanship of Secretary of Interior Cecil Andrus. It identified the following major problems:

- Despite serious water supply problems in several parts of the country, there is no national emphasis on water conservation.
- There are wide variations in the techniques used to estimate benefits and costs in planning federal water projects.
- Some of these water projects are unsafe, economically unjustified, or environmentally destructive and do not reflect adequate compliance with existing laws and regulations.
- State governments have major water management responsibilities but do not share significantly in the planning, selection, and funding of water resource programs and projects.

Twenty-five federal agencies now spend more than $10 billion per year on water resources projects and programs, and there is a backlog of more than 1,900 federal projects in various stages of planning and construction. Of these, 1,280 are authorized or underway. They will cost an estimated $34 billion in federal funds to complete.[47]

The Water Policy Message is directed to all executive departments and agencies, but the Army Corps of Engineers, Interior's Bureau of Reclamation, Agriculture's Soil Conservation Service, and the Tennessee Valley Authority are most affected because they are most heavily and directly involved in planning and constructing federal water resource projects. Their activities account for nearly $4 billion in federal funds each year. Most of the rest of federal funds for water programs are spent for grants and loans, especially EPA's $5 billion municipal waste water treatment program. It is not directly affected by the Water Policy Message.

Water Conservation

The water policy review analyzed data on water supply and consumption for each of the 106 watershed subregions in the United States, comparing water use levels with surface and ground water availability for 1975 and projecting supply and use for 1985 and 2000. Figure 6–2 summarizes the results. Some major findings follow.

The 17 western states account for approximately 85 percent of all water consumed in the United States. Consumption is the portion of water withdrawn, used, and not returned to the source. In other parts of the country, a much smaller proportion of water supplies is *consumptively* used although water withdrawals are substantial. Withdrawals in the West are 40 percent of the nation's total. The rest of the country accounts for 60 percent of the withdrawals but only 15 percent of the total consumption.

A severe water shortage exists now in 21 subregions, mainly in the Central Plains and southwestern states. A potentially severe

Figure 6-2

Water Supply Deficiencies by Watershed Region

Current problems

Arizona, New Mexico, Texas, Oklahoma, Kansas, Nebraska, Nevada, Southeastern Wyoming, Central and Southern California, Eastern and Central Colorado, Western Utah

Future problems

Montana, South Dakota, Wyoming, Southern Idaho, Southeastern Oregon, Southern Florida, Northern California, Eastern Utah, Western Colorado, Western North Dakota

Source: U.S. Water Resources Council, *1975 National Assessment* (Washington, D.C., 1978).

shortage is anticipated in 18 regions by 2000, mainly in the Northern Plains states, Rockies, and northern California, if consumption grows as projected. The 21 subregions already suffering water shortages cover 28 percent of the U.S. land mass and include 13 percent of the population. Over 90 percent of the water consumed in these areas is used by agriculture, mainly for irrigation. In the subregions suffering shortages, one-third of consumption comes from a fixed stock of ground water, which either cannot be renewed or can be replaced only at a very high cost. Ground water "mining" is most prevalent in the Texas High Plains region, the lower Colorado, the Great Basin in Nevada and Utah, and parts of California.

Given the accelerating depletion of ground water in many areas and the fact that ground water can be replenished only by surface supplies, surface water must play a key role in meeting the future needs of water-deficient areas. At present, approximately 40 percent of the surface water diverted for irrigation in the 17 western states is supplied by federal projects constructed by the Bureau of Reclamation.

Urban water consumption represents less than 6 percent of the national total. However, urban water consumption increased 13.5 percent between 1970 and 1975 while populations receiving urban supplies increased only 6 percent. The result has been seasonal or short-term water shortages in certain urban areas outside the western states, such as Boston, Washington, D.C., and Atlanta. In these areas the problem often is not lack of water in the subregion but the high cost of constructing the supply system.

Initiatives in the President's Water Policy Message to encourage conservation include technical assistance, federal program reforms, and pricing. Agencies are directed to make water conservation a condition of federal funding for municipal water supply and sewer systems or for receiving federal aid for housing programs. Water conservation measures will also be required at federal facilities. Several agencies will give increased technical assistance (approximately $15 million annually) for water conservation by farmers and urban dwellers, and new approaches will be developed for the government's farm assistance programs to encourage conservation and discourage overextension and ground water depletion.

Besides these direct efforts for water conservation, the government will continue to reform pricing of water supplied by federal agencies. It is already required that new and renegotiated contracts must include provisions to renegotiate water rates every 5 years, and that requirement will be continued. The 40-year contracts which were previously the rule often do not reflect inflation and thus do not meet the repayment obligations of beneficiaries. The recovery of a more appropriate share of capital costs will also be ensured by more rigorous implementation of the "ability to pay" provision in existing law, on which repayment arrangements are currently based.

Environmental Protection

The environmental problems of water projects are much larger in scope than the occasional "endangered species" controversies. For example, flood control, navigation, and drainage projects have eliminated several million acres of productive agricultural and forest land and valuable wetlands and marshes. Prior to passage of the National Environmental Policy Act, agencies undertaking water projects were not explicitly required to assess environmental values. Even now, when detailed analysis of environmental impacts and protection of important environmental values is required by law, in many cases the analysis has been inadequate and enforcement of statutes has been inconsistent and ineffective. Further, environmental mitigation funds have not been adequate to offset losses.

The President ordered a number of actions to increase the level of attention given environmental values in planning and constructing federal water resource projects. Agencies are to implement fully and comply strictly with environmental laws such as the Fish and Wildlife Coordination Act and the National Historic Preservation Act. Moreover, funds for environmental mitigation must be included in all appropriation requests for construction of projects and must be spent concurrently and proportionately with construction funds.

Executive Order 11988 on floodplain management, which is intended to reduce flood hazards and protect floodplains from unwise development by federal projects and programs, must be implemented promptly by all agencies. The Water Policy Message encourages agencies to use existing federal programs for nonstructural flood protection—including land acquisition—where consistent with the primary purposes of the agencies' programs.

Over the past 2 years the Agriculture Department has already taken steps to improve the Soil Conservation Service watershed program and to reduce adverse environmental impacts. The Department reviewed inactive or controversial projects and, jointly with the Fish and Wildlife Service, adopted new guidelines for modification of stream channels. The SCS now requires that at least 50 percent of specified land treatment measures must be in place before dam construction begins. The President specified additional steps to improve the SCS watershed program, such as making appropriate land treatment measures eligible for federal cost sharing if they directly contribute to control of soil erosion or water pollution.

A most important environmental consideration is protection of flow in existing streams when water projects are built. Failure to do so jeopardizes recreation, water quality, esthetics, and fish and wildlife habitat. Because federal water programs have often ignored the need to maintain instream flows, many streams have become critically depleted, especially in the West. The President directed federal agencies to work with the states to improve the operation and management of existing projects to protect instream use. Although such protection is essentially a state and local function, the federal government has some duties in this connection. For example, EPA

has certain responsibilities in conjunction with the states to protect the quality of underground water as drinking supply. In many areas where legal protection of ground water is lacking, problems have arisen and the federal government has been called upon to provide water resources development. To improve federal cooperation with states, the President directed that federal water resources agencies assess ground water problems as projects are planned and work closely with states and local governments to resolve the problems. Federal agencies are to offer states assistance and information about instream flow and ground water withdrawals.

Federal Planning and Evaluation

Improving the Principles and Standards Federal water project and program planning is generally governed by the Principles and Standards issued by the Water Resources Council in 1973. The P&S established federal planning objectives, a process for formulating plans, and guidelines for computing benefits and costs. However, as indicated earlier, benefit and cost calculations are often inconsistent or inaccurate because agencies do not interpret the guidelines correctly or use inappropriate or outmoded data or estimation techniques. As a result, projects are often portrayed as being economically justified under current standards when they are not.

The Water Policy Message reaffirmed the basic objectives and procedures of the Principles and Standards and directed the Water Resources Council to improve their application and specificity. The Water Resources Council is to evaluate the benefit-cost calculation procedures now in use by agencies and develop a new planning manual incorporating the best current techniques. The new procedure should eliminate double counting and inclusion of benefits that are inconsistent with federal policy or sound economic rationale.

The Water Resources Council is also directed to integrate water conservation into the P&S as a part of the economic development and environmental quality objectives. Further, it is to require as one alternative the preparation of a plan that is primarily nonstructural. This alternative may include measures to reduce demand.

The water policy review found that no entity other than the construction agency itself now effectively monitors water project planning. The President therefore directed that an independent review function be established by Executive order within the Water Resources Council. A professional staff of about 30 will review preauthorization and preconstruction plans of the federal agencies to see whether the plans are consistent with established planning procedures and manuals, including the WRC Principles and Standards and established benefit-cost calculation and estimation procedures.

Presidential Project Selection Criteria Each year numerous water resource projects are proposed by federal agencies for planning and construction funding. The water project review conducted during the spring of 1977 made clear the need for specific criteria for selecting water projects to include in the budget. Eleven criteria

will now form the basis for Presidential decisions on funding of water projects.

One of the most significant of the criteria is that projects selected for funding should have net national economic benefits unless the environmental benefits clearly more than compensate for any economic deficit, and if there are adverse environmental consequences, economic benefits should significantly outweigh them.

Enhanced Federal–State Cooperation in Water Management

The water policy review supported the view of the states that they should be the focal point for water resource management. In keeping with that philosophy, the President announced initiatives for strengthening federal-state relations in this area.

Planning and Technical Assistance Grants The President proposed a substantial increase in the 50–50 matching program to aid state water planning. Currently authorized at $5 million annually, the state grants program for water resources planning is carried out by the Water Resources Council.[48] The authority of this program is broad; its goal is to improve the quality and effectiveness of state water resources planning. The President's proposal to the Congress is to raise the funding for the program to $25 million per year to help states develop comprehensive water planning programs.

In conjunction with the aid for water resources planning, the President is also proposing $25 million annually for matching grants to states for technical assistance programs to further water conservation. Technical assistance includes public education and research, but not the purchase of equipment.

Cost-Sharing Changes Under existing cost-sharing rules, the federal government pays an average of 70 percent of the costs of federal water resource projects. The rest is covered by local project sponsors or beneficiaries. States seldom participate in project funding and do not play a major role in setting project priorities. Under current formulas the nonfederal contribution to water resource projects differs among agencies and types of projects. Projects in which the nonfederal share is lower may therefore be more attractive to local sponsors and users. For example, structural flood control measures have generally required less nonfederal funding than nonstructural measures, resulting in a bias toward structural solutions. Another result has been heavy public subsidies to specific industries and individual beneficiaries at the expense of the general taxpayer.

Two important goals of the cost-sharing proposals in the Water Policy Message are to involve the states more closely in water project decisions and to eliminate conflicting rules governing cost sharing for flood control projects, especially those for structural and nonstructural measures to reduce flood damage.

The President directed the Water Resources Council to prepare the necessary legislation to make construction of federal projects contingent upon a contribution by states. The states will contribute

10 percent of the construction costs associated with "vendible outputs"—outputs offered for sale—of water projects producing benefits within their borders. States will also contribute 5 percent of the costs of other project purposes. Revenues from vendible outputs will be shared between the federal government and the states in proportion to their investments. The proposal is to apply the state cost-sharing requirement to projects that are not yet legally authorized and to encourage voluntary contributions for projects that are authorized but not yet under construction. Authorized projects for which states are making voluntary contributions will be given expedited funding consideration.

The new requirement for state cost sharing would be in addition to existing cost-sharing arrangements. The present rules would be modified, however, to require a 20 percent nonfederal contribution for federal flood damage reduction measures, both structural and nonstructural. This would make cost sharing for structural measures the same as those now in effect for nonstructural measures. The requirement would apply to the Soil Conservation Service, although SCS watershed projects would be exempt from the 10 percent–5 percent state cost-sharing proposal.

CONGRESSIONAL ACTION ON WATER PROJECTS

On June 13, 1978, shortly after issuing the Water Policy Message, the Administration sent to the Congress its 1979 budget recommendations for construction of 26 new water resources projects. These were the first new starts to receive Presidential support in 4 years. But the list was not received favorably on Capitol Hill because the House of Representatives was already considering its own authorization and appropriation bills,[49] which included a much longer and different list of projects. Despite the promise of a veto, the House passed an appropriations bill that funded over 2 dozen projects not supported by the Administration, including eight which the Congress had agreed not to fund in the previous fiscal year.

The Senate rejected an Administration-backed amendment to the omnibus rivers and harbors authorization bill [50] which was intended to establish user fees for commercial navigation. A substantial user fee requirement was the Administration's stated condition for accepting one of the bill's other provisions, the authorization of a replacement for Lock and Dam #26 on the Mississippi River.

As of mid-1978, both bills awaited further action in the Congress.

MINING AND MINERALS

SURFACE MINING FOR NONCOAL MINERALS

Surface mining is most extensive and best known in the case of coal. Yet it is recognized that mining for other materials may also

seriously disrupt the environment. Phosphates, copper, sand and gravel, and uranium are a few examples of minerals for which surface or open pit mining and processing operations can cause extensive damage to natural ecosystems.

Surface and open pit mining has destroyed plant and animal communities, removed valuable topsoil, and caused significant adverse effects on surface and ground water systems. Mining and processing activities can cause degradation of water quality many miles away from the disturbed site.[51]

In the Surface Mining Control and Reclamation Act of 1977,[52] the Congress authorized CEQ to contract for a comprehensive study by the National Academy of Sciences to assist in the establishment of reasonable regulation of surface and open pit mining and reclamation for minerals other than coal. Following completion of the study, CEQ will recommend specific legislation to the President and the Congress.

Phosphate mining on both public and private lands has received particular attention in recent years. It has caused significant damage to environmental systems in Florida, North Carolina, and Idaho.[53] Hundreds of thousands of acres of phosphate-mined land remain unreclaimed, and hundreds of thousands more will be mined before the turn of the century. The phosphate problem is most evident in central Florida, where 80 percent of the U.S. output and approximately 33 percent of the world total of marketable phosphate rock are mined.[54]

The intense concern in central Florida over the environmental impact of phosphate mining prompted CEQ to ask EPA to prepare a regional environmental impact statement. The draft EIS, released in April 1978, acknowledges that phosphate is an essential component of fertilizer but also sets forth the adverse environmental impacts of phosphate mining and processing.[55]

Both the mining and beneficiation (separation of phosphate from sand and clay) operations consume millions of gallons of water—a serious matter in central Florida. Water is drawn from the Floridan aquifer, a large confined (artesian) aquifer system in which recharge tends to be slow. This aquifer is the major source of water for industry, agriculture, and municipalities in the region.

Surface mining of phosphates also releases radioactive radon gas to the atmosphere and radium to surface and ground water systems. These radioisotopes are decay products of uranium, which is generally found together with phosphate. Other ecological problems of phosphate mining include impacts that are common to surface mining of many materials: diversion of creeks and streams, destruction of all the vegetation on the mining site, removal and loss of topsoil, and adverse alteration of animal habitats.

Phosphate mining on public lands has generated acute controversy. Currently under consideration is the question of whether certain holders of prospecting permits under the Mineral Leasing Act of 1920 are entitled to preference right leases in the Osceola National

Mining and lumbering activities on both public and private lands raise issues of water pollution. Here bulldozers strip overburden from a phosphate mining site in the Centennial Mountains, Montana, and a truck loads logs in the Eldorado National Forest, California.

Forest in north central Florida. Issuance of these leases would result in mining some 30,000 acres within the forest. The Osceola National Forest contains unique vegetative communities and endangered wildlife species which would be adversely affected by these mining operations.[56]

Phosphate mining on 16,000 acres of federal land (primarily the Caribou National Forest) in southeastern Idaho is also likely to produce significant environmental problems. By the turn of the century, still other phosphate resources on the public lands may be exploited. EPA has recently suggested that regulations under the Surface Mining and Reclamation Act of 1977 covering the reclamation of coal surface mined lands be adapted to fit phosphate development in southeastern Idaho. The National Academy of Sciences study will consider the suitability of these regulations for phosphate and other noncoal minerals.

Recently President Carter asked the Secretary of Interior and the Director of the Office of Science and Technology Policy to investigate the need for a broad review of the government nonfuel minerals policy. A review was found necessary to help the Administration develop a systematic evaluation of minerals policy options. Health, safety, and environmental effects of these mining operations will be investigated in this review.[57]

HARD ROCK MINING ON THE PUBLIC LANDS

Under the 1872 Mining Law, still in force today, prospectors and miners of gold, uranium, iron, copper, and all other hard rock minerals have free access to the vast acreage in the public domain. Unlike all other commercial users, miners can enter federally owned lands without a permit or license. They can claim any marketable body of ore that they find, and they can dig the ore and sell it without paying any royalty to its owners, the nation's citizens. Where a valuable mineral deposit exists, they can take title to the land itself—at prices that have not changed since 1872, $2.50 to $5 per acre, depending on the kind of claim.

The century-old Mining Law does not allow adequate control of environmental damage caused by mineral development. Nor does it permit orderly planning for use of the public lands. Under the law, hard rock mining can simply preempt other valuable uses such as wildlife, range, timber, watershed, and wilderness instead of taking its place with the other uses in a rational process of planning and choice. Roughly 750 million acres—nearly one-third—of the nation's land area is publicly owned, and 60 percent of that is open to mining.[58]

The 1872 Mining Law had one single purpose, to promote mining. It expressed the spirit of its time, when the federal government was handing over public lands and their resources to private citizens to encourage settlement and development of the West. But as the frontier closed and demands on the land increased and con-

flicted with each other, the nation began to impose restraints. Lumber companies, for example, may now cut only in designated areas under environmental supervision and they pay for the timber that they cut. Ranchers must have permits and pay a fee to graze their stock on the public lands. Coal, phosphate, and other minerals once freely available under the 1872 Law are now leased under the 1920 Mineral Leasing Act. Only hard rock mining remains exempt.

Today, as President Carter noted in his 1977 Environmental Message, the Law is "outdated and antiquated." At the President's direction, the Interior Department prepared a bill for reform of the Mining Law and submitted it to the Congress in September 1977. The bill provides for multiple use of the public lands, payment of royalties, and continued public ownership of the federal lands and their wealth as well as assistance to small mines and needed incentives for mineral development. The proposed new law would ensure protection during and after mining and would keep discretion over mining on the public lands in the hands of the owners' agent, the federal government.

FORESTS

MANAGEMENT OF NATIONAL FORESTS

Allowable Cut

In October of 1977 the Council on Wage and Price Stability suggested raising the annual allowable cut on Forest Service and BLM lands, predicting that the increased supply of lumber would help reduce the rising costs of home construction.[59] Following this suggestion, in April of 1978 President Carter instructed the Department of the Interior, the Department of Agriculture, CEQ, and his economic advisors to prepare a report on "the best way to sustain expanded timber harvests from Federal, state and private land and other means of increasing lumber yield in ways that would be environmentally acceptable, economically efficient and consistent with sound budget policy." [60]

The study ordered by the President drew renewed attention to longstanding issues and controversies over timber harvests on the public lands. In recent years the timber industry has urged increased cutting in the National Forests, particularly of the highly prized old growth Douglas fir trees in the Pacific Northwest. Timber stocks of private industrial forest land in the region are close to depletion after decades of increasing harvests to meet the demands of World War II and the postwar housing boom without adequate replanting to replace harvested timber. (In earlier years, replanting did not appear profitable to many private operators. Impending shortages and rising timber values have made reforestration a better investment, and many industrial forests are replanting today on a large scale.)

Because new plantations on private forest lands in the Northwest are not yet replacing the cuts of earlier years, the Forest Service and others project a decline in yields from these lands. A 1976 study from Oregon State University on timber production projected a 22 percent decline in western Oregon's timber production by 2000.[61] A still sharper drop for private industry lands—49 to 59 percent—has been projected between 2000 and 2075, based on present management policies. Even with more intensive management —planting, control of competing vegetation, use of chemical fertilizers and herbicides, monoculture, and development of fast-growing strains—the study anticipated little effect on the projected yield for the next 25 years. Oregon contributes 20 percent of the nation's softwood supply. In the South, another important softwood region, production is not expected to decline in the next 2 decades.

Environmental groups have emphasized the costs of raising allowable cuts of the mature old trees on the public lands. Most of the remaining old growth Douglas fir in the Northwest is in the National Forests, but a great deal of it is on poor growing sites where replacement timber could take 150 to 200 years to mature. Moreover, the old growth in places is located on steep or inaccessible lands which could be reached only by expensive, environmentally destructive roads. Taking all mature trees from the National Forests would produce increased timber yields in the short term but is contrary to even-flow sustained yield policies which ensure that the National Forests will produce a continuous supply of high quality timber for future generations.

Conservation policy also protects other highly prized forest values such as watershed, wildlife, wilderness, recreation, and scenic beauty. Even when intelligent environmental safeguards are applied, intensive management of private forests for high yields and good profits does not give as much emphasis to these values as does multiple-use management of the forests that are owned by the public. Federal forests are managed for values that benefit everyone in general but enrich no one in particular and at the same time offer renewable commercial resources over the very long run. The National Forest Management Act of 1976[62] and the Multiple-Use Sustained Yield Act of 1960[63] wrote into law that timber harvests in the National Forests must be based on sustained yield and that the lands must be managed to meet a broad range of publicly beneficial goals.

Land Management Plans and Resource Assessment

The Resources Planning Act of 1974[64] and the National Forest Management Act of 1976 require the Forest Service to develop land and resource management plans integrating recreation, range, timber, watershed, fish and wildlife, and wilderness uses for the entire 187-million-acre National Forest System. The Forest Service, working with a committee of scientists, is now developing new planning regulations in accord with the 1976 Act. The new regulations

will guide the preparation of approximately 150 integrated land use plans for the National Forests.

The RPA also required the Forest Service in 1975 to make a comprehensive assessment of the nation's renewable resources in both public and private ownership and to develop a long-term program for protection and management of the resources under its own jurisdiction. The Assessment and Program are to be updated in 1980 and every 10 years thereafter.

Following hearings in the summer and fall of 1977, the Subcommittee on Forests of the Agriculture Committee of the U.S. House of Representatives evaluated the 1975 Assessment and Program.[65] Among the Subcommittee's 27 recommendations to improve implementation of the RPA were suggestions for increasing the participation of the public, the states, and other federal agencies, improving the land management planning process, stabilizing the analysis procedures in the Assessment and Program, and developing better program alternatives.

Several of the Forest Service programs outlined in the RPA and NFMA, such as timber stand improvement, reforestration, and timber sales, fell short of the 1975 RPA Program estimates because of funding shortages and the extreme summer drought of 1977.

Forestry Improvement

The Department of Agriculture and the Congress have both responded to the President's recommendations to improve the nation's timber supply through "forestry programs [which] support national environmental goals." [66]

Three major bills before the Congress call for extension services, educational programs, and technical assistance and cost sharing for states and private forest owners.[67] All three bills received unanimous support in identical wording from the House and Senate Agricultural Committees. Another bill proposed by the Administration would provide Federal Crop Insurance protection for timber producers in line with the President's recommendations for creating incentives to benefit private nonindustrial foresters.[68]

After issuing a report to the White House in September 1977 on how the federal government could respond to the President's recommendations,[69] the Department of Agriculture created a forestry planning committee. Its job is to coordinate the forestry programs of the several agencies and to assign various agencies roles in state forestry planning, education, technical assistance, and incentives. The Department is also investigating three approaches to implementing the study proposals presented to the President in September: allowing the free market to control the nation's forestry and timber needs, continuing current federal efforts, and changing and increasing federal forestry programs.

HERBICIDES IN FORESTRY

The Forest Service reported in 1978 that "[n]o significant adverse effects have occurred from the use of pesticides on National Forest Lands." [70] Yet pesticide use on public and private land continues to stir controversy. In a 1977 report the Environmental Protection Agency pointed out the need for strict guidelines to prevent improper application of silvicultural chemicals, which are divided into three major categories—fertilizers, herbicides, and insecticides-rodenticides.[71]

Although the EPA report found that water pollution from the use of chemicals in forestry is not a widespread problem, other problems were identified: use of persistent herbicides, excessive use of insecticides, and improper application techniques on forest lands. Recommended measures to control water pollution resulting from silvicultural chemical treatments included restricting the use of certain insecticides, maintaining adequate buffer strips along the shores of waterways where chemical treatment would be disallowed, training and licensing capable applicators, and a general goal of adopting management practices which require a minimum of chemical treatment.[72]

In April 1978 the Department of Agriculture announced a revised pesticide policy which included restrictions on the application of 2,4,5-T to National Forest lands. The extremely toxic chemical dioxin is a constituent of this herbicide. All proposals for its use on forest lands will be studied by the Assistant Secretary of Agriculture for Conservation, Research, and Education.[73]

The revised policy emphasizes the Forest Service policy to encourage the use of integrated pest management methods, systems, and strategies with the least hazard to people, their possessions, wildlife, and the natural environment. Natural controls and selective measures are to be adopted as rapidly as possible.[74] Even though relatively little pesticides are applied to Forest Service lands—less than 0.2 percent of its lands were treated with pesticides in 1976 [75]—the Forest Service role as a silvicultural model for the nation is important. The new USDA policy points to a shift in emphasis from a narrow cost-benefit approach to consideration of other highly important values, such as protecting the environment from unnecessary chemical applications and preserving the long-term environmental integrity.

ALASKA LANDS

Legislation to protect Alaska's vast wilderness has been called "the highest environmental priority" of the Carter Administration and "the most important conservation action of the century." [76] The long-brewing controversy over management of Alaskan lands came

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to a head in 1978, the year designated by the Congress in 1975 as the deadline for congressional action.

The federal government is Alaska's greatest landholder. The Statehood Act of 1959 entitles Alaska to select 103 million acres of federal lands.[77] The native corporations representing Alaska's indigenous peoples will select and take title to more than 44 million acres, as authorized by the Alaska Native Claims Settlement Act of 1971 (ANCSA).[78] But even after these selections, the federal government will still control 220 million acres—almost 60 percent of Alaska. Of Alaska's 375 million acres, about one-eighth currently in the four systems of protected public lands: the National Forest, Parks, Wildlife Refuges, and Wild and Scenic Rivers.

Intense, sometimes bitter controversy has arisen in Alaska and the other 49 states over how much more of the vast federal acreage will be included in the four systems. The debate focused on two differing philosophies of land management, whether to put primary emphasis on protecting Alaska's magnificent, irreplaceable wilderness or whether to give more weight to development of the state's immensely valuable resources.

Section 17(d)(2) of ANCSA directed the Secretary of Interior to set aside up to 80 million acres of federal lands in Alaska for study as potential additions to the four systems. The Congress must act on the Secretary's recommendations by December 18, 1978, or else extend the deadline. Otherwise the withdrawals of the study lands will expire, and the Bureau of Land Management will manage the lands according to policies of multiple use and sustained yield.

During the congressional hearings on the disposal of federal lands in Alaska, witnesses expressed the full range of opinion.[79] Chairman Morris Udall of the House Committee on Interior and Insular Affairs presented a proposal which in its original form would have added about 113 million acres to the four systems. The bill (H.R. 39) was described by development interests as a "lockup" of Alaska's resources. But supporters of the bill pointed out that hundreds of millions of acres of state, private, and federal lands, including some of the four systems lands, would remain open to development. They emphasized that Alaska's vast wilderness is the last in the United States.

The original Udall proposal was criticized for its wilderness provisions. Wilderness lands are managed to preserve the land in a natural condition, virtually undisturbed by the imprint of human activity. The bill would have set aside about 145 million acres of federal lands in Alaska as wilderness, immediately increasing tenfold the acreage of the existing National Wilderness Preservation System nationwide.

Subsistence hunting, sport hunting, access to state and native lands, and assignment of four systems areas of the National Wilderness Preservation System were also major issues in the Alaska lands debate.[80]

THE ADMINISTRATION BILL

In September 1977 the Department of the Interior submitted to the Congress the Carter Administration's recommendations for managing the federal lands in Alaska. The Interior proposal would add nearly 92 million acres to Alaska's protected public lands in 10 new National Parks, 9 new Wildlife Refuges, 33 Wild and Scenic Rivers, and additions to existing Systems' lands. He called the proposal "the bottom line of what is necessary to protect [Alaska's] unique values." [81]

The Administration has recognized the special need for wilderness in Alaska,[82] and Secretary Andrus recommended about 50 million acres for immediate designation as wilderness. In addition, the Interior Department will complete its review of wilderness study areas of highest priority by 1981 and by 1985 should have finished its study of all other potential wilderness acreage on the four systems' lands under the Secretary's jurisdiction.

The subsistence hunting rights of native and bush Alaskans is another major issue. This age-old use of renewable plant, fish, and wildlife resources was endorsed by the Administration, which proposed that the Secretary of Interior be empowered to designate zones for "traditional subsistence uses at the 1971 level" throughout the four systems lands.[83] Continuation of these subsistence rights will take precedence over sport hunting privileges on the public lands whenever the wildlife resources become endangered. Sport hunting, according to the Administration bill, would not be allowed on Park lands but would be permitted in the Wildlife Refuges—totaling more than 49 million acres—and 11 million acres of National Preserves under the jurisdiction of the National Park Service.

Recommendations for new National Parks in Alaska include the Gates of the Arctic National Park in the Brooks Range, where preservation of wildlife habitat, hiking, and backpacking would be paramount.

The management of commercial mineral, fuel, and timber resources has also been a point of contention. The Administration designed its four systems proposals to exclude as far as possible areas with commercial resource potential where development would conflict with objectives for managing highly protected lands. Although the proposals affect about one-fourth of Alaska's land acreage, they are estimated to include a far lower percentage of Alaska's known commercial wealth. Many lands with more valuable minerals and timber will be selected by the state and by the native corporations, and millions of acres will remain available for multiple use management under the administration of the Bureau of Land Management.

The Administration proposal exempts the National Parks, Refuges, and Wild and Scenic Rivers from mineral exploration and development except where valid mining claims already exist. Wilderness areas, under Section 4(d)(3) of the Wilderness Act of 1964, will be closed to new mineral leasing after January 1984.[84] Wildlife Refuges, according to the Administration bill, will remain open to "discretionary oil and gas leasing."[85] The National Forests will continue to be managed according to their present policies, which are based on the principles of multiple use and sustained yield.

On the issue of access for motorized vehicles use, the Administration rejected the idea that "transportation corridors be carved out of nationally significant d-2 * lands before the need for such access is established, the impact on the resource is known, and all viable alternatives have been considered." [86] However, recognizing that aircraft, boats, and snow machines have become essential in remote areas of Alaska, the Secretary proposed the continued use of snow machines for subsistence, management, and emergencies.

To minimize land title conflicts among the state, native, and federal interests, the Administration announced a philosophy of federal restraint in cases of "dual selection." When more than one interest seeks title to the same piece of land, the federal government will relinquish its claim except when the national interest would clearly be served by federal land jurisdiction. The federal government will also work closely with the state and with the native corporations to provide just distribution of Alaska lands with maximum cooperation among the various interests.

STATUS OF THE LEGISLATION

In May 1978 the House of Representatives, by a margin of 277–31 approved a redraft of the original Udall bill, which reserved more land to the four systems than the Administration recommended as the minimum acceptable. In mid-1978 the Senate had not yet voted on the matter. Opponents of the Administration proposal and the House bill included both Senators from Alaska.

* Section 17(d)(2) of the Alaska Native Claims Settlement Act.

WILD AREAS

WILDERNESS

The National Wilderness Preservation System continues to grow slowly, though the potential exists for great expansion in the future. Today the System includes 16.5 million acres (less than 2 percent of all public lands) and has increased by about 7 million acres since passage of the Wilderness Act of 1964.[87]

President Carter's strong support for expansion of the Wilderness System on the public lands, expressed in his 1977 Environmental Message, was reflected in the Administration's proposal to designate 50 million acres of wilderness in Alaska. President Carter also urged passage of the Endangered American Wilderness Act of 1978.[88] Enacted by the Congress in February, it added 1.3 million acres of land in the western National Forests to the Wilderness System. In signing the Act, President Carter noted that it "represents the largest single addition to the wilderness of our country since the original enactment of the Wilderness Act in 1964." He said that the bill "is critical in preserving areas that are a vital part of our national heritage." [89]

Another major wilderness addition which passed the Congress was the Absaroka-Beartooth area in the Custer and Gallatin National Forests in Montana and Wyoming.[90] Its 900,000 acres of wilderness expanded the total Wilderness System to more than 16.5 million acres. Other areas—some of them specifically included in the President's 1977 Environmental Message—were considered as part of Representative Philip Burton's omnibus parks bill,[91] which drew together more than 100 proposals for improving the nation's four systems of protected public lands and included proposals for 5.6 million acres of wilderness.

Still before the Congress is the wilderness proposal for the Boundary Waters Canoe Area under Forest Service administration in northern Minnesota's lake country. More than 1 million acres have been proposed for wilderness by the Administration.[92] On June 5, 1978, the House sent this legislation to the Senate for consideration. As of July 1978, the Senate had not acted.

Last year the Forest Service broadly expanded its search for potential wilderness areas, and the Bureau of Land Management began the 15-year process—mandated by the Congress in the Federal Land Policy and Management Act of 1976 [93]—which will result in recommendations to the Congress by 1991 on which areas will or will not be added to the Wilderness System from BLM lands.

The potential effects of these federal wilderness study efforts are enormous. The initial stage of the Forest Service Roadless Area Review and Evaluation has inventoried for consideration for wilderness 62 million acres in over 2,600 roadless areas[94]; that is 6 million acres more than the area identified in the first review in 1972. The objective of the study, according to the Forest Service, is "speedy determination of which areas are needed to help round out a quality

National Wilderness Preservation System." [95] The Forest Service will determine which roadless areas to propose as wilderness or to allocate to nonwilderness uses and also which areas need further planning before a decision is made about their suitability or nonsuitability for wilderness.

The Forest Service is considering "ecosystem and landform representation, accessibility and distribution, and the presence of certain wilderness-associated wildlife [as] important elements of an 'ideal' wilderness system." [96] Regional, social, and economic concerns, as raised during the public comment stage of its wilderness review in the summer of 1978, will also be considered before wilderness recommendations are sent to the Congress.

According to its final Wilderness Inventory Handbook released in September 1978, BLM plans to inventory its lands and catalog those with wilderness potential: roadless areas of more than 5,000 acres, roadless islands, and some smaller areas with "outstanding" wilderness characteristics. These inventoried lands will be studied to determine their suitability or nonsuitability for preservation as wilderness.[97] From these study lands, BLM will make recommendations to the President by 1991 on which areas should and should not be added to the National Wilderness Preservation System. Within 2 years of the BLM recommendations, the President may propose the areas to the Congress for wilderness designation.

One proposal for BLM wilderness has already been made; in his 1977 Environmental Message, President Carter recommended the Aravaipa Canyon Primitive Area in Arizona. As soon as BLM completes its wilderness procedures, Aravaipa Canyon, 10 other BLM primitive areas, and 44 natural areas—totaling more than 2 million acres—will be studied for wilderness suitability.

Other land management agencies of the Interior Department are also reviewing their lands to decide whether they are suitable for wilderness designation. Current proposals for Park Service wilderness total almost 43 million acres, of which 31 million are in Alaska. The Fish and Wildlife Service will administer 13.1 million acres of Alaska lands as wilderness under the Administration's proposal.

WILD AND SCENIC RIVERS

By October of 1976, more than 1,650 miles of the nation's premier waterways had been entered into the National Wild and Scenic Rivers System, established in 1968.[98] No new mileage has been added to the System in nearly 2 years, although there have been recommendations for additions from states, the federal government, and conservation groups. The proposed National Parks and Recreation Act of 1978, H.R. 12536 (the omnibus parks bill), included eight recommendations for new Wild Rivers and 17 for wild river study. Five of the President's eight 1977 recommendations [99] are in the bill.

During the summer of 1978, the Heritage Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation) completed its survey of eastern rivers with Wild and Scenic River potential.

The Skagit River in Washington, designated by the Congress in 1968 for wild and scenic study, became the center of controversy when several years ago the Puget Sound Power and Light Company proposed constructing two nuclear power generators on the River about 60 miles north of Seattle. In 1975 the Department of Agriculture determined that Section 7 of the Wild and Scenic Rivers Act restricted the development of federally assisted water resource projects on the Skagit, proposed for wild and scenic status. Since then, USDA has completed its investigation of the conflict and recommended wild and scenic designation for most of the study area—in conjunction with strict design, construction, and operation conditions for the two proposed nuclear generators.

The study for wild and scenic potential incorporated about 166 miles of the river, including the project site. President Carter's recommendations for designation of 157.5 miles of the study area also include the project site; although "portions of the project" [100] would be outside the designated area, the impacts of the water discharge pipe and barge offloading facility would not occur within the designated river.

The Skagit was included in the National Parks and Recreation Act of 1978, passed by the House of Representatives, with no reference to the proposed powerplant.

PARKS AND REFUGES

THE NATIONAL PARKS

The National Park Service has undertaken a major management improvement project which will concentrate on two basic principles —decentralization, so that Park supervisors can deal individually with the problems of their unique territories, and retention of the "line management system," which clearly outlines responsibilities and authorities among Park Service staff.

Additions to the Park System over the past year were small but highly controversial. The proposal to add some 48,000 acres of adjacent redwood forest to the Redwood National Park was a subject of bitter debate. One faction argued that the redwoods should be harvested and that expansion of the Park would cause regional economic depression. The opposition argued that timber harvest on the adjacent lands would severely damage the resources within the existing Park.[101] After a long debate and several hearings, the Congress approved the addition and the President signed the Redwood National Park Act in March 1978.[102] It makes available federal aid to prevent local economic damage and protects the

Redwood Creek drainage so that future additions will probably not be necessary. (For further discussion, see Chapter 10, Economics.)

The Administration supported a proposal to remove the Mineral King Valley from the Sequoia National Forest in California and add it to the adjacent Sequoia National Park. If the move is made, an $80 million ski resort and development proposal for the Valley will not be built. In the Mineral King Valley case, demands for skiing and other winter sports near Los Angeles conflict with the value of preserving unspoiled forest land. The proposal to put Mineral King Valley in the Sequoia National Park was included in the National Parks and Recreation Act of 1978.[103]

In May 1978 the Senate passed a bill creating a universal access policy for National Parks.[104] The bill would require the Park Service to provide public transportation systems within the Parks and eventually disallow private vehicle traffic where it can be avoided. The House had not taken action by mid-1978.

THE NATIONAL WILDLIFE REFUGES

The Fish and Wildlife Service administers approximately 34 million acres of the public lands for the primary purpose of protecting and increasing wildlife populations.

The Fish and Wildlife Service is developing procedures for preparing individual refuge master plans that will include objectives, management, activities, and resources. A special Task Force on Management of the Refuge System in January released a report with 26 recommendations for improving management of the System. The Task Force said that they would "lead to a larger, more diverse, and more highly coordinated refuge system than exists today," adding that "the refuge system must be a strong, viable, clearly identifiable unit which stands for protection of the environment and against encroachment on the Nation's natural heritage." [105]

The Refuge System grew by 26,000 acres in the past year through direct purchase and acquisition of easements.

GRAZING

Long-continued mistreatment of the public rangelands has resulted in a widespread degradation of the range. As noted in previous Annual Reports, Forest Service and BLM estimates indicate that less than one-fifth of the public range is producing as much as 60 percent of its capability.[106]

BLM's latest estimates show no recent change in the trend of rangeland conditions. About 16 percent of the public range is still declining in condition, 65 percent is static or uncertain, and 19 percent is improving.[107] Through new grazing regulations published in the spring of 1978,[108] adjustments of livestock use levels, and

improvements such as revegetation, BLM hopes to repair the damaged rangeland and reverse the trend of deterioration.

However, BLM notes that "the conditions observed on these rangelands are disquieting." With a vast domain of nearly one-half billion acres to manage, BLM has difficulty protecting its rangelands from overuse.

In a study of grazing fees submitted to the Congress in October of 1977, the Departments of Agriculture and the Interior estimated that about 25,000 ranchers graze 8 million head of livestock on the public lands for an average of approximately 2½ months per animal per year.[109] Fewer than 400 ranchers account for more than one-quarter of the grazing on the public lands.

Raising the fees for grazing permits to a level comparable with the costs of grazing on private lands is important not only to assure an adequate return to the public for the use of its resources but also, indirectly, to protect the quality of the public range. The costs of grazing on the public lands have consistently been about one-third of the average commercial costs, and the discrepancy has led to overgrazing and deterioration.

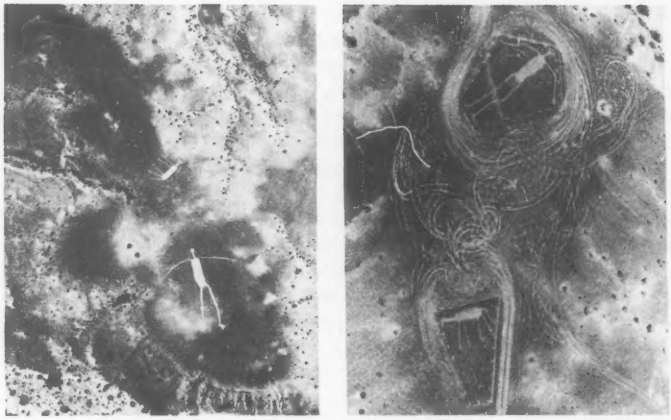
Recent bills passed by the House and the Senate would devote large amounts of federal money to range improvements on the public lands.[110] The bills include a fee schedule which falls short of the Administration-backed fair market value fee collection system.

The Forest Service's Resource Planning Act program calls for improvement of about 18 million acres of unsatisfactory rangeland by the year 2000. Range revegetation was completed on 115,000 acres in 1977, and improved livestock allotment management contributed to better range conditions on another 35,000 acres. Measures to improve 200,000 more acres in accordance with the RPA program were not undertaken because of federal budgetary priorities.[111]

BLM, directed by a court order in December 1974 to prepare environmental impact statements on grazing programs,[112] completed the first one, for the Challis Planning Unit in Idaho, in early 1977.[113] In response to criticism of this first effort, a draft supplement to the EIS was published in September 1978. Final EISs for eight other units were completed as of October 1978. BLM planned to inventory some 12 million acres of rangelands during the 1978 field season to build a data base on soils and vegetation for future grazing program environmental statements.

OFF–ROAD VEHICLES ON THE PUBLIC LANDS

The use of off-road vehicles on public lands has grown dramatically over the last decade; the environmental damages that they can cause is increasingly evident. Damage by ORVs has been documented in every kind of ecosystem in the United States, from North Carolina beaches to San Francisco hills. (Snowmobile use



The unspoiled intaglio at the left was photographed in 1932 near Blythe, California. The 1975 photo at the right shows extensive vehicle damage (there are three sets of intaglios in the immediate area; none is the same as shown on the left, but all three have suffered similar degradation).

on adequate snow cover is an exception.) ORV damage is especially evident in the California desert, where use is heavy and the desert ecosystem is easily damaged and slow to recover. Motorcycle sales have jumped from fewer than 400,000 registered in the United States in the late 1960's to 8.3 million by 1976. Snowmobile sales have also grown rapidly. During the 1968-69 season, 265,000 of these vehicles were sold throughout North America; an estimated 2.2 million are in use today. The number of four-wheel-drive vehicles is not known but probably exceeds 3 million. Total ORVs in use in the United States now exceed 10 million. ORV riders may represent as much as 25 percent of the population.[114]

In 1977 President Carter revised a 1972 Executive order and directed the federal agencies to control the use of ORVs where they have caused or seem likely to cause environmental damage.[115] Implementation of the order has been slow; by mid-1978 the Bureau of Land Management had closed only approximately 2.5 million acres of damaged lands in California, Idaho, and Nevada and was still reviewing its proposed regulations for the use of ORVs on the public lands. In an environmental impact statement on the Interior Department's implementation of the Executive order, the Heritage Conservation and Recreation Service presented an 11-year program for designation, closure, and regulation of BLM lands.[116]

In August the Forest Service completed its rulemaking to control ORV use on forest lands. It reported that ORV use on Forest Service lands increased by 6 percent in 1977, totaling more than 4.1 million recreation visitor-days. Approximately 40.7 million acres of Forest Service lands are closed to all ORV use, excluding all wilderness and primitive areas, another 31.1 million acres are restricted to specific vehicles and seasons, and of 115.9 million acres open to

ORV use, the Forest Service reports that "a significant portion . . . is unavailable . . . due to inaccessibility, vegetation, topography or other physical barriers." [117]

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CHAPTER 7

ECOLOGY AND LIVING RESOURCES

DISRUPTION OF NATURAL SYSTEMS

Living resources—forests, fisheries, wildlife—are usually described as renewable. Behind this term lies the unspoken assumption that they will restore themselves through natural regenerative processes, even when repeatedly depleted.

From the time of European settlement, this assumption has underlain our actions. When explorers and colonists first arrived on our shores, they were astonished at the richness and variety of the New World's wildlife. John Cabot, exploring Newfoundland in 1497, noted the mast-sized trees that came to the water's edge, and his son, Sebastian, reported that salmon, sole, and codfish were "so abundant as to slow up the advance of the ship." [1] To these first arrivals and others who followed, it seemed that the continent's bounty was inexhaustible.

Yet the fact is that the regenerative capacity of nature cannot always make up for the excess of human actions. A pattern of abuse—characteristic of most of our history—can relegate living resources to nonrenewable status. The gold removed from Sutter's Creek in 1849 cannot be mined again; neither can the passenger pigeon meat that was marketed by the tons in our major cities 100 years ago again be consumed.

Living systems are intrinsically renewable resources. A forest wilderness may be used as a wilderness in perpetuity; fish from a large natural spawning run may be wisely harvested year after year. But abuse of such natural systems may cause changes which would take decades or longer for natural processes to bring about recovery.

A natural system may be converted to a managed system that provides renewable resources. For example, when wilderness is converted to a tree plantation the wilderness itself becomes nonrenewable (at least within the span of a human lifetime), but timber production can be practiced on a renewable basis in the converted area. But in other cases of human alterations of nature, the living system simply ceases to be, and no substitute, renewable or otherwise, takes its place. The extinction of species following destruction of habitat is an example of such an occurrence.

Living resources may be termed nonrenewable if the recovery time of the natural system exceeds the time scale of most social processes—that is, between several decades and a century. Some human insults to natural systems are so profound that they can persist through geologic time scales, and some are irreversible. Living resources in these systems have been made nonrenewable.

Use of natural systems should be based on awareness of the results of our actions. Any changes in natural systems should be considered closely before they are undertaken, and particular attention should be paid to changes in natural systems which take longer than a human lifetime to reverse. In many instances such changes satisfy social needs in ways for which there is no alternative. For example, all farmland was once part of some natural system—a forest, wetland, or grassland prairie. Under cultivation, this land may be able to provide for the food needs of many more people than it could support in a natural state. And when wisely managed, it can remain productive for centuries. Rene Dubos has remarked on the beauty, order, and stability of the French countryside, which has been farmed for thousands of years with no loss of fertility.[2] Yet there are innumerable examples of environmental degradation and permanent uncompensated loss when stable ecosystems are altered by human activities. For example, attempts to convert tropical forest into pasture have failed after a few years, as the benefits of the forest cover for water retention, soil enrichment, and temperature control are lost.[3]

The choice of preserving a natural system in a pristine form, of converting it to a different, highly managed renewable system, or of converting it to a nonrenewable system often rests upon different social values. However, the social values which are implicit when we choose among them should be recognized and the choices made consciously. One of these social values is to "fulfill the responsibilities of each generation as trustee of the environment for succeeding generations." [4] In many cases natural systems are thoughtlessly abused to satisfy short-term goals at the expense of long-term needs.

AN AQUATIC ECOSYSTEM: THE GREAT LAKES

The Great Lakes once provided some of the richest commercial fisheries in the United States. The collapse of this resource was caused by a number of human actions which had cummulative effects, sometimes accompanied by changes in natural conditions.[5] Overfishing resulted in the loss of the lake sturgeon and cisco as commercial species by 1900. A subspecies of cisco became extinct about this time. Today the blue pike is on the Endangered Species List in part because of earlier overfishing. Thus even before the 1940's, as shown on Table 7–1, the stocks of native fishes of the Great Lakes were already severely stressed when the effects of another human action, undertaken long before, began to be felt.

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Table 7-1

Catch of Selected Fish Species in Lake Huron, Selected Years 1879–1940

Species	Period	Average annual catch (pounds)	Percentage of "normal"[1]
Whitefish	1879–94	1,682,214	100
	1895–1921	892,810	53
	1922–29	1,438,745	86
	1930–35	3,144,444	187
	1936–40	692,423	41
Lake trout	1879–94	2,362,460	100
	1895–1935	1,720,201	73
	1936–40	1,264,279	54
Northern pike	1899–1923	84,029	100
	1924–31	36,444	43
	1932–39	14,660	17
Sturgeon	1879–93	303,317	100
	1894–99	73,078	24
	1900–1907	25,122	8
	1908–27	6,655	2

[1] "Normal" indexed to the 1879–94 population as 100.

Source: International Board of Inquiries for the Great Lakes, *Fishery Report and Supplement* (Washington, D.C.: U.S. Government Printing Office, 1943), p. 80.

Since colonial days, the nation's waterways have been altered to provide cheap, convenient carriage of cargo. Sometimes the natural barriers which were breached to improve the efficiency of transport were the same barriers which isolated discreet living communities. The 326-foot cascade of Niagara Falls, which blocked passage to the Great Lakes, was once an impassable barrier for both goods and living organisms.

The Welland Canal, opened in 1829, bypassed Niagara Falls, with the result that species which were not native and had never before been present gained access to the upper Great Lakes. The most notorious of these species was the parasitic sea lamprey whose initial slow colonization of the Great Lakes illustrates the time bomb effect of some human actions on the environment. The first lamprey was not found in Lake Erie until 1921. The species did poorly there, but it ventured farther into the upper Great Lakes, becoming established in Lake Huron in 1932, Lake Michigan in 1936, and Lake Superior in 1946.[6] Here the species prospered and essentially eliminated fish higher in the food chain such as lake trout and burbot. Table 7–2 shows how the lake trout declined as the lamprey population increased. Other important species such as whitefish and walleye were also severely affected.[7]

The removal or reduction of these major predators had important reverberations through the food chain. Without them the lower links could expand unchecked. A small marine herring, the alewife, was accidentally introduced in Lake Ontario about 1870. By 1954, it

Table 7-2

Lake Trout Production (Thousand Pounds) and Sea Lamprey Abundance (Percentage of the Mean Counts of Spawning Runs) in Lakes Huron and Michigan 1930–66

Year	Huron[1]		Michigan	
	Lake trout	Sea lamprey	Lake trout	Sea lamprey
1930	2993		5441	
1931	3263		5632	
1932	3457	([2])	5470	
1933	3313		5212	
1934	3138		4957	
1935	3812		4873	([2])
1936	3538		4763	
1937	3094		4988	
1938	3017		4906	
1939	2622		5660	
1940	1979		6266	
1941	2002		6787	
1942	1528		6484	
1943	976		6860	
1944	676	[3]50	6498	
1945	290	68	5437	
1946	68	90	3974	[3]3
1947	19	111	2425	16
1948	14	145	1197	27
1949	4	275	343	43
1950	<1	210	54	148
1951	<1	216	11	345
1952	<1	105	4	90
1953	<1	130	<1	252
1954	<1	113	<1	199
1955	<1	153	<1	164
1956	<1	122	0	155
1957	0	91	0	165
1958	<1	61	0	80
1959	<1	31	<1	68
1960	<1	84	<1	52
1961	<1	53	<1	101
1962	0	58	<1	63
1963	1	52	26	59
1964	1	30	<1	36
1965	1	15	<1	26
1966	<1	36	<1	[4]9

[1] Excluding Georgian Bay and North Channel.

[2] Year of first evidence of establishment of sea lamprey.

[3] First year for which counts are available.

[4] Year in which the first round of chemical treatment of lamprey-spawning streams was completed.

Source: W.I. Aron and S.H. Smith, "Ship Canals and Aquatic Ecosystems," *Science* 174:15 (1971).

had spread to Lake Superior.[8] The alewife was not found in Lake Michigan until 1959; its arrival coincided with the loss of the predators from sea lampreys. The alewife population increased spectacularly to become a major nuisance. Another small fish, the American smelt, which was accidentally introduced into the Lake

Michigan drainage basin in 1912, also flourished and its population expanded during this period.

After extensive research a successful program to control the larvae of the sea lamprey has been developed. At the same time, a major sport fishery has been successfully established in the Great Lakes. Efforts to introduce top carnivore fish species, especially salmon, date back to the 1870's.[9] As the original lake fisheries declined throughout the period before World War II, attempts to stock salmon and other valuable fish continued in the hope of developing a new commercial fishery. None was successful.

After World War II, management efforts turned toward sport fishing. States bordering the Great Lakes launched major stocking programs of salmon and trout through the 1950's and 1960's.[10] In Lake Michigan especially, the results have been outstanding, with high survival rates and rapid growth. The successful progress of the Great Lakes sport fisheries is indicated in Table 7–3.

Despite their apparent success, however, both the lamprey control program and the artificially propagated sport fishery depend on continued human effort. Although limited spawning of sport fish has taken place, maintenance of the fishery still requires large annual stocking. Lamprey control depends on the continuous application of costly strategies such as chemical poisoning of larvae.

In judging the success of the programs, one must keep these facts in mind:

- The original ecosystem has been lost and can never be replaced.
- The managed ecosystem that has taken its place is artificial and must be continually controlled by removing lamprey and adding salmon, and the cost in dollars, energy, and human effort is high.
- In the absence of human intervention, the new system would rapidly degenerate.

Overall, Great Lakes water quality has shown improvement in the last several years. However, because the salmonids introduced into the lakes are top carnivores, those pollutants that are still present

Table 7-3

Estimated Salmonid Catch in the Upper Great Lakes 1975

Salmonid	Lake Michigan	Lake Superior	Lake Huron
Lake trout	512,000	217,000	
Steelhead	545,000	88,000	78,000
Brown trout	145,000	31,000	67,000
Brook trout	8,000	1,000	
Coho salmon	740,000	94,000	79,000
Chinook salmon	558,000	22,000	225,000
Total	2,508,000	453,000	449,000

Source: Memorandum from Fishery Biologist to Director, Great Lakes Fishery Laboratory, La Crosse, Wisconsin, October 27, 1976.

accumulate in the food chain and reach high concentrations in salmon flesh. High levels of both mercury and PCBs in the Great Lakes have caused great concern, and sport fishermen have been warned about excessive consumption of their catch. Although there are signs that the mercury situation is improving, PCB levels in fish flesh have not significantly changed in 8–9 years.[11]

In brief, the Great Lakes are a system so thoroughly perturbed by people that it is difficult to imagine their original fisheries ever again becoming a true renewable resource. Stability, even in the presently managed ecosystem, has not been achieved. An analysis of the fish data available for the Great Lakes region concluded that as late as 1971 there were no signs of a new equilibrium.[12]

The history of the Great Lakes—those immense natural reservoirs which hold one-fifth of the world's freshwater—demonstrates the extraordinary consequences of human actions. An important commercial fishing industry in several states is completely destroyed; the replacement sport fishery is plagued by bioaccumulation of toxics; the ecosystem is chronically out of balance among predator (salmon), prey (alewife and smelt), and parasite (lamprey) and requires continual human subsidy; and several species or subspecies have become either endangered or extinct.

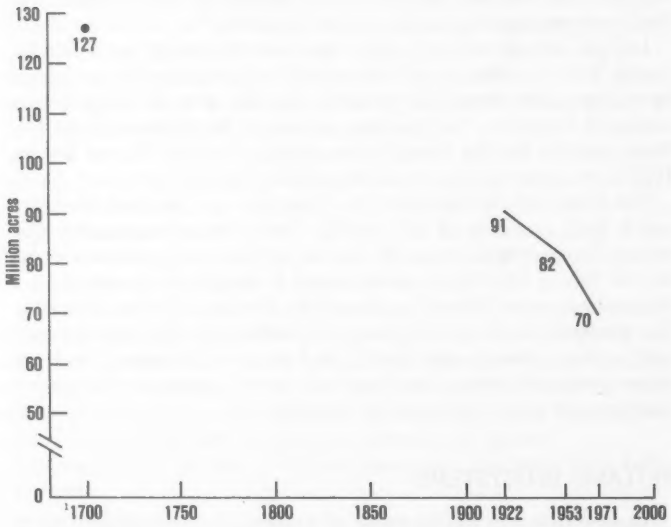
WETLAND ECOSYSTEMS

An understanding of the value of wetlands in their natural state has been late in coming. For most of the country's history, even until very recent years, draining of wetlands for farmlands or using them as sites for roads, airports, industrial plants, commercial buildings, waterfront homes, and marinas, even trash dumps, was not questioned. Their great biological productivity, their value in storing water and reducing flood damage, recharging aquifers, and removing organic pollutants by natural processes, is only now being fully recognized. (See Chapter 5, Human Settlements, for a discussion of legal protection of wetlands.) A historical outline of wetland destruction in the United States by human activities is shown in Figures 7–1 and 7–2. Exact figures are not available, but the Fish and Wildlife Service is engaged in a comprehensive wetland inventory, and results for several areas will soon be published. Historical data show long-continued losses of wetlands. According to the Fish and Wildlife Service, of an initial 127 million acres of wetlands in the lower 48 states, only 87 million acres remained in 1954. It is estimated that by 1971 another 17 million acres had been lost, with 70 million acres remaining.

Wetlands are of many types, including coastal saltwater marshes and mangrove swamps, inland marshes and swamps, peat bogs, and glacial potholes. All are highly productive biologically and provide nurture and habitat for a great quantity and variety of wildlife. Riparian wetlands—those which lie along streams, lakes, and rivers —offer an excellent example of the wildlife values of wetlands.

Figure 7-1

Wetland Acreage in the United States 1700-1971



[1]Presettlement.

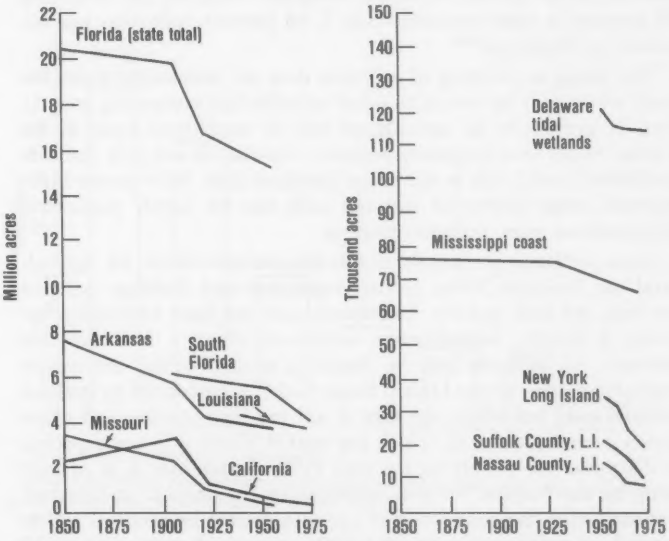
Source: Samuel P. Shaw and C. Gordon Fredine, U.S. Department of the Interior, Fish and Wildlife Service, *Wetlands of the United States*, Fish and Wildlife Circ. 39 (1953), pp. 6-7; William Niering and Richard Goodwin, *Bulletin of the Ecological Society of America* (June 1974), p. 4.

In the arid West, riparian wetlands are usually shrubby forest adjacent to waterways. In the East, they are generally floodplain and bottomland hardwood forests. No ecosystem is more essential to the survival of the nation's fish and wildlife. For example, western riparian ecosystems contain approximately 42 percent of the mammal species of North America, 38 percent of the bird species, 30 percent of the reptiles, and 14 percent of the amphibians.[13] Seventy-seven percent of the breeding birds [14] and 75 species of fish of the Southwest are dependent upon riparian ecosystems.[15] Eastern wildlife most severely affected by the loss of riparian wetlands include otter, muskrat, mink, beaver, racoon, Canadian geese, and wood ducks.[16]

Endangered species are associated with at least 20 percent of all riparian lands. Nine riparian wetland habitats are on the Critical Habitat List and 17 more are proposed. A critical habitat is defined by the Endangered Species Act of 1973 as the area of land, air, or water required for the normal needs and survival of a species listed as threatened or endangered. Sixty-four species which are dependent

Figure 7-2

State Wetland Acreages 1850-1975



Sources: Samuel P. Shaw and C. Gordon Fredine, U.S. Department of the Interior, Fish and Wildlife Service, *Wetlands of the United States*, Circ. 39 (Washington, D.C.: U.S. Government Printing Office, 1956), p. 7; personal communication with Don Young, Florida State Planning Office, Tallahassee, Florida; U.S. Department of Commerce, National Oceanic and Atmospheric Administration and the Louisiana Department of Wildlife and Fisheries, *Cooperative Gulf of Mexico Estuarine Inventory and Study, Louisiana:* Phase I, Area Description, and Phase IV, Biology (New Orleans: Louisiana Department of Wildlife and Fisheries, 1971), p. 10; S.M. Gagliano *et al.*, "Deterioration and Restoration of Coastal Wetlands," reprinted from *Proceedings of 12th International Conference of Coastal Engineering*, Washington, D.C. (Jackson, Miss.: The Gulf Coast Association of Geological Societies in Jackson, Mississippi, 1970), p. 7; Peter Sullivan, "Versatile Wetlands—An Endangered Species," *Conservation News* 41(5):20 (1976), p. 5; U.S. Department of the Interior, Fish and Wildlife Service, *Supplementary Report on the Coastal Wetlands Inventory of Delaware* (Washington, D.C.: U.S. Government Printing Office, 1965); Kathi Jensen, "Search for the Wetlands," *Delaware Conservationist* 19(16):2 (1965); U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and Mississippi Marine Conservation, *Cooperative Gulf of Mexico Estuarine Inventory and Study, Mississippi* (Ocean Springs, Mississippi: Gulf Coast Research Laboratory, 1973), pp. 16, 179, 180; New York State Department of Environmental Conservation, Office of Planning Services, *Long Island Marine Wetlands: Status, Value, and Preservation Potentials* (Albany: Office of Planning Services, 1972), pp. 9-10.

upon riparian ecosystems have been listed as endangered, and 47 more, including the river otter, have been proposed.[17]

Overall, 70 to 90 percent of all original riparian habitat in the United States has been destroyed. Along the Colorado River, for example, less than 10 percent of the original riparian habitat remains,[18] and only 5 percent remains in the lower Gila Valley.[19] Between 1936 and 1972, one-half the riparian habitat in the San

Pedro Valley was lost.[20] In Missouri, 17 percent of the riparian habitat was destroyed by 1880, 40 percent by 1920, and by 1975, only 4 percent remained.[21] In the South, where bottomland hardwoods and wildlife were once so productive, there has been a 47 percent loss of riparian habitat in Arkansas—with the loss exceeding 95 percent in some counties—and a 68 percent reduction has occurred in Mississippi.[22]

The filling or draining of wetlands does not necessarily waste the land, which may be turned to other valuable but competing uses. In fact, 24 percent of all agricultural soils in nonfederal lands in the United States were originally wetland. One-half of wet soils (outside nonfederal lands) falls in the prime farmland class. With proper management, some converted wetland soils can be highly productive farmlands for years, perhaps centuries.

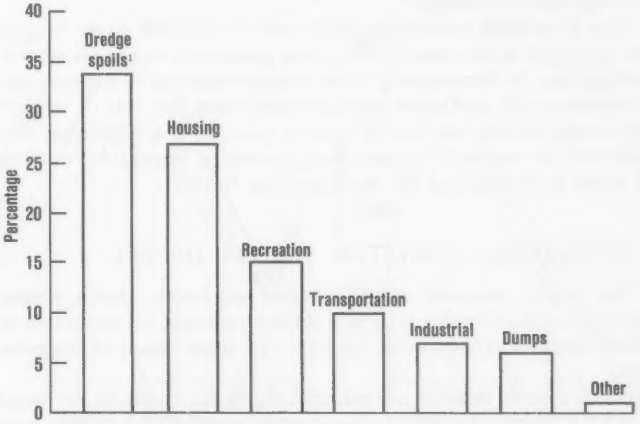
Some wetlands are totally unsuitable for conversion for agricultural use, however. When natural vegetation and drainage patterns are lost, the soils quickly deteriorate, and the land eventually becomes a barren, unproductive waste—in effect a nonrenewable resource. An example may be found in south Florida, the winter vegetable garden of the United States which is supported by drained wetland soils, but where the rate of soil loss by oxidation and other causes is on the order of 1 inch per year.[23] These soils are expected to disappear completely by the year 2000. Agriculture is at present using up the "capital" of soils produced by the original undisturbed wetland. After the soils are used up, they cannot be renewed unless natural conditions are restored, but the process of restoration could require centuries.

Can wetland ecosystems in fact be restored after they are disrupted by human activities? That depends in part upon the nature of the disruption. Figure 7–3 shows the uses to which wetlands between Maine and Delaware were converted in the decade between 1955 and 1964. Most of these uses represent permanent commitments of land; it is economically and perhaps biologically unfeasible to restore them to the status of renewable resources. Where the alteration of the wetland is not irreversible—where, for example, the hydrologic regime remains unaltered and plants could come back if allowed—restoration can perhaps be accomplished through natural succession. Even so, the costs may be significant and the time required long.

In Florida, for example, it is proposed to undo the channelization of the Kissimmee River because of the project's damaging effect on water quality.[24] Partial restoration of the River's original meandering course and most of the original 35,000 acres of riparian wetland is projected to cost about $48 million, $15 million more than the initial cost of channelization only 10 years ago.[25] However, the long-term benefits of the natural wetland are expected to outweigh the climbing cost of combatting the water quality deterioration by other means.

Figure 7-3

Use of Filled Wetlands, Maine to Delaware 1955-64



[1]Creation and maintenance of waterways.

Source: John Clark, *Fish and Man: Conflict in the Atlantic Estuary,* Spec. Pub. 5 (Highlands, New Jersey: American Littoral Society, 1967).

Similar considerations led President Carter to propose in his 1977 Environmental Message the deauthorization of the Cross-Florida Barge Canal project and the restoration of the Oklawaha River to its natural condition. In this case it was shown that the region derives significant benefits—in flood control, maintenance of water quality, abundance of wildlife, recreation (including hunting), and savings in funds to control exotic aquatic weeds—from restoration. Restoration costs were estimated at $9.2 million for the whole canal project.[26] The savings from the Rodman Reservoir area alone in the form of aquatic weed control and the benefits of having the natural floodplain forest there would pay back that amount in only 5 years.

Referrals of past decisions to alter or destroy wetlands, even when substantial spending will be required, clearly indicate that the value of the undisturbed natural resource was overlooked in the first place. These reversals also suggest that natural ecosystems can sometimes provide an alternative that is preferable to irreversible development. By managing wetland ecosystems as renewable resources, we can often derive more value from them than by altering them and in addition leave open more options for use in the future.

A system of natural wetlands was incoporated into a large regional flood control project in the Charles River Basin in Massachusetts. The U.S. Army Corps of Engineers concluded after a 5-year study that flooding problems in this river basin could best be resolved by maintaining 8,500 acres of wetlands in their natural state in

perpetuity. The Corps calculated an annual flood control value for these wetlands of $1,203,000 or $142 per acre. This project, known as the Natural Valley Storage, is now in its "construction phase," which in this case means the gradual acquisition of wetlands from 525 separate ownerships.[27]

The Kissimmee restoration plans and the Charles River projects are examples of the new trend toward increasing awareness of wetland values. As documenting these values continues to improve and compliance with protective measures progresses, the rate of wetland loss should decline, and more, possibly most, of our remaining wetlands will be kept in a natural state, providing renewable resources of value to humankind for the long-time future.

A TERRESTRIAL ECOSYSTEM: THE BIG THICKET

The major terrestrial natural systems are forest, tundra, desert, and grassland. All suffer generally similar problems of conversion to other uses, loss of vegetation, erosion, and other forms of degradation.

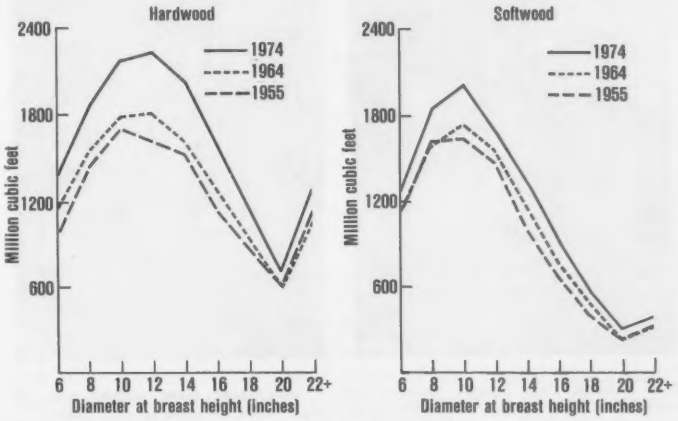
Forest systems provide a good example of the values to be found in a great natural terrestrial ecosystem, of competing uses that provide renewable resources on a managed basis, and of other uses which lose all renewable resource values.

In their undisturbed state, forests provide recreation, watershed protection, and unique scenic beauty while also serving as the basis for a natural community that provides life support to animals (including people) and other plant species. Lumber and pulp for paper are beneficial resources produced by forests which with proper management may be indefinitely renewable. Yet a forest managed for high commercial yield must lose certain characteristics and values of a natural diverse forest ecosystem. If a natural forest is converted to a managed tree farm system, there is an associated loss of habitat for wildlife, for example, dead trees used by birds and mammals for nest sites. Esthetic qualities of special value decline and recreational opportunities are changed. Because the life cycle of the dominant tree species of a natural forest ecosystem is very long, restoration to a mature natural state from row crop agriculture or tree farming would take decades to centuries, depending on the original forest ecosystem. Although the conversion of natural forests to other uses may result in establishing a new renewable resource base, the original natural system itself cannot be readily restored.

The southeastern states are a microcosm of much of the nation's forest situation. The amount of land in the region devoted to forest and foresting is declining, as is the timber yield, shown in Figure 7–4. In the Mississippi Delta, substantial loss of wetland forests has occurred. Of 11.8 million Delta acres in forest in the early 1930's, some 40 percent have been converted to soybean cultivation and other nontimber uses.[28] This conversion is occurring for several reasons. Besides the economic advantage to farmers who do not have

Figure 7-4

Volume of Hardwood and Softwood Growing Stock by Tree Diameter 1955, 1964, and 1974



Source: Herbert A. Knight and Joe P. McClure, *North Carolina's Timber, 1974*, USDA Forest Service Bull. SE-33 (Asheville, North Carolina, 1975), Figs. 8 and 9, pp. 8-9.

to wait out a 15-year harvest cycle, government price supports, property taxes, and other influences encourage this trend.[29]

A remarkable example of both the conversion of a large forested natural community to alternative human activity-dominated uses and the preservation of part of that community in the National Park System is found in the Big Thicket area in east Texas. This area originally encompassed some 3.5 million acres with exceptionally diverse and beautiful vegetation.[30] It contained a variety of natural communities, including floodplain hardwood forests, bald cypress-tupelo swamps, beech-magnolia-loblolly forests, and Savannah wetlands. The National Park Service believes that 9 species of endangered plants and 10 species of threatened plants may occur in the Preserve.[31] Eight endangered animal species may occur, possibly including the red wolf.[32] (A precise inventory of the fauna has not been taken but will be available if the Big Thicket is developed as a preserve by the Park Service.)

The timber industry and railroads moved to the Big Thicket area in the 1880's and 1890's. Additional development pressure has come from agriculture and drilling for oil. To these pressures, extensive real estate development for resorts and vacation homes has been added. Three million people live within a 100-mile radius, and Houston is 2 hours away by automobile. Over the past three-quarters of a century, land use changes have resulted in the loss of most of the original habitat of the diverse fauna and flora of the region.

Because the Big Thicket is a truly unique area, its continued modification and loss attracted national attention. There have been

The National Park Service believes that 9 endangered plant species and 10 threatened plant species may occur in the Big Thicket Preserve in east Texas.

efforts for more than 30 years to preserve this regional and national resource. In 1974, the Congress authorized the establishment of an 84,550-acre Big Thicket Preserve—which will amount to about 3 percent of the original Big Thicket. The National Park Service currently is acquiring this land in 12 tracts in an attempt to obtain the most significant remaining examples of the original ecosystems.

Despite the protection that these tracts will have as part of the National Park System, they will still be affected by activities in other parts of the original Big Thicket outside the National Preserve.[33] Adjacent lands are subject to timber harvesting, agriculture, grazing, hunting, various industrial uses, extraction and transport of oil, and residential development—all of which could seriously conflict with the purpose of the Preserve. So far, the National Park Service has reported water quality problems resulting from silting from nearby logging, dumping of salt brine from oil drilling activities, and high BOD values from septic tank effluents. The nearby conversion of natural timber to plantations of pine monocultures may cause serious forest pest problems, deficiencies in wildlife habitat, and unnatural soil and moisture conditions. Offsite activities are also responsible for esthetic intrusions into the Preserve, including visual intrusions from conflicting uses of the land, noise from timber cutting, and odors from oil operations and a nearby paper mill. Because the Park Service does not own all the land proposed for the National Preserve and regulations are still in the formative stage, no positive course of action to relieve these problems has yet been adopted. It is not likely that land use management and zoning will provide protection; these tools are looked upon with disfavor in the region.

Already there is some pressure on the NPS to permit hunting and oil and gas exploration and extraction within the Preserve.

Preservation of a small part of this unique area represents an investment in the value of natural systems for the future. Yet the problems identified by the Park Service in managing the Preserve for its legislated purpose suggest that the nation does not have a clear title to its investment.

Most of the Big Thicket has been converted to other long-term uses, including the production of both renewable (trees) and nonrenewable (oil) resources, uses on which society places a high value. But without preservation of this remnant as a National Preserve, examples of this unique ecosystem would vanish entirely.

DISTURBED FAUNA

The changes in the biota of a region mirror the alterations that human activity has effected in that region. Human beings have extensively modified the natural biota by introduction of competitors, predators, and disease, by direct killing, and by habitat alteration. Disturbances to the native fauna of the United States since European settlement serve as a useful indicator of overall changes to the living landscape from sophisticated human activities, especially since the industrial age began. Changes we have brought about in the bird fauna are especially interesting indicators.

In Hawaii, for example, many of the native species have become extinct or are in danger of becoming so. Drepanididae, the Hawaiian Honeycreeper, is the one family of birds which exists only in the Hawaiian Islands. Of the 23 species in the family, 8 are already extinct and 9 others are endangered. One-half the remaining six have at least one recognized race in danger or extinct.[34] The collapse of this native fauna took place principally in the second half of the 19th century. Loss of habitat from agricultural expansion was one important reason. But the species suffered seriously from competition with introduced exotic competitors from both hemispheres, including such species as the cardinal, introduction of exotic predators such as mongooses, and also diseases carried by introduced bird species.[35]

Alteration of the bird fauna in the United States is not limited to Hawaii. Early observers of North American wildlife commented on the tremendous flocks of gamebirds that darkened the sky: "The air was literally filled with Pigeons, . . . the light of noon day was obscured as by an eclipse." [36] Today in many parts of the country, the skies are again darkened by birds, but because of changing land use practices and the introduction of exotic species, the flocks are now composed of starlings, grackles, native blackbirds, and cowbirds. Roosts of millions of birds have been reported, especially in Kentucky and neighboring states, as shown in Figure 7–5. They are a nuisance because of their noise and excrement; they cause crop loss by their feeding and may serve as hosts to potentially serious human diseases such as certain strains of encephalitis.

Figure 7-5

Blackbird-Starling Populations, January-February 1977

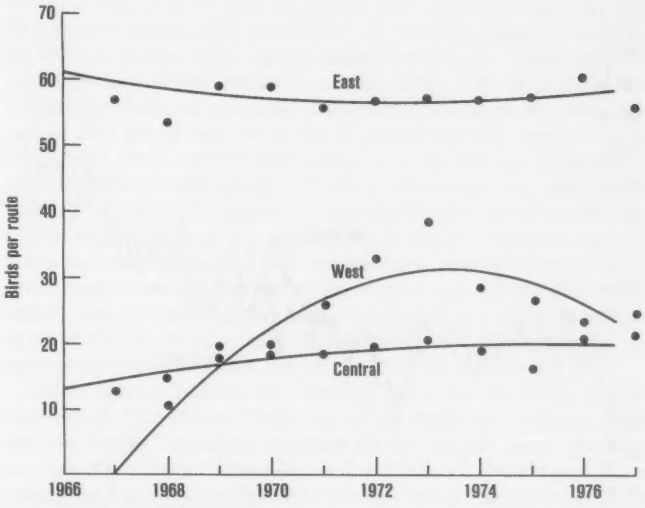
Source: W.C. Royall, Jr., Denver Wildlife Research Center, U.S. Fish and Wildlife Service, "Blackbird-Starling Roost Survey, January-February 1977," Bird Damage Research Report 50, 1977.

Admirers of the starling deliberately introduced the species into the United States in 1890. The starling is extremely aggressive and has displaced many native competitors. Soon after it was introduced, it quickly spread through the eastern states and has had a large but stable population there for many years. As Figure 7–6 shows, starling populations were increasing dramatically in the West until the early 1970's but are now decreasing. In the eastern and central parts of the country, populations have remained fairly constant.

Much of the increase in the starling and native blackbird population has taken place because of changes in agriculture and land use. Figure 7–7 illustrates the growth in production of grain crops which are important sources of food to these species. In the last 20 years, the acreage devoted to feed grain has about doubled, and production of food grains has increased by about one-third. As indicated in Figure 7–6, the Grain Belt states have experienced greater population

Figure 7-6

Starling Population Trends 1966-77



Source: U.S. Fish and Wildlife Service data.

increases in these species than the rest of the nation. Although large roosts of blackbirds have occurred earlier in our history, their present magnitude is clearly a result of human activities.

Attempts to control this nuisance have met with little success. Recorded distress calls are ultimately as ineffective as scarecrows. Large-scale operations to kill whole roosts by destroying their waterproofing with a chemical detergent under certain weather conditions have had only mixed success, as shown in Table 7–4. Even if today's large flocks and roosts of blackbirds could be reduced through chemicals or other means, the original balanced avifauna of preindustrial North America can never be restored, so great has been the effect of human activities.

A most important influence on changing composition of avifauna has been changes in size and degree of mechanization of farms. In 1967, average farm size was twice what it had been in 1940. With the rapid increase in size and greater mechanization, monocultures replaced the multiple crop farm. The impacts on the abundance and variety of wildlife have been dramatic. The trends can best be illustrated with changes observed in Illinois, where bird surveys are available for 1906–1909 and 1956–58.[37] The total number of breeding birds changed little during this time, but species populations changed considerably. Of the species most abundant in Illinois in the early part of the century, 17 decreased (including the Mock-

Figure 7-7

Production of Grain Crops 1910-75

Source: U.S. Department of Agriculture, *Changes in Farm Production and Efficiency*, Stat. Bull. 561, 1976, Table 1, p. 5.

Table 7-4

Effectiveness of Chemical Wetting Agents against Blackbird Populations for All Roosts Treated, Fiscal Years 1977 and 1978

Site	Treatment date	Pretreatment population	Percentage killed
Flintville, Tennessee	1–5–77	2,000,000	55
Flintville, Tennessee	1–23–77	850,000	74
Milan, Tennessee	1–13–77	1,200,000	92
Russellville, Kentucky	1–13–77	4,000,000	95
Munfordville, Kentucky	2–11–77	3,100,000	19
Lawrenceburg, Tennessee	12–?–77	1,250,000	0
Lawrenceburg, Tennessee	1–16–78	1,250,000	70
Flintville, Tennessee	12–29–77	575,000	93
McMinnville, Tennessee	1–19–78	5,200,000	19
McMinnville, Tennessee	1–25–78	4,200,000	97
Sommerville, Tennessee	2–19–78	NA	0
Sommerville, Tennessee	3–2–78	NA	0
Munfordville, Kentucky	2–27–78	NA	0

NA = Not available

Source: U.S. Fish and Wildlife Service, Animal Damage Control.

ingbird, Gray Catbird, Brown Thrasher, Eastern Kingbird, Eastern Bluebird, and Redheaded Woodpecker), 6 held their own (Common Grackle, Grasshopper and Vesper Sparrows, Killdeer, and Eastern Meadowlark), and 17 increased notably (including the Barn Swallow, Starling, Red Winged Blackbird, and Horned Lark). In 1909, 18 species comprised 70 percent of the breeding birds of the state; by 1958, 6 species made up the same percentage. Two were introduced exotics (House Sparrow and Starling). The simplification of the habitat over half a century favored the few aggressive adaptable species that could survive in the new environment created by humans, and those species that were more completely dependent on natural habitats did poorly. By their abundance the species that prosper may give the impression that wildlife has not been altered.

The replacement of the native bird fauna by these few species is a loss not only because of the nuisance and possible health hazards from huge roosts of agressive blackbirds; the esthetic loss of the charm and variety of many kinds of songbirds is hard to measure but nonetheless is very real. Futhermore, loss of diversity in ecosystems generally means a loss of resilience or stability.

Other species besides the Starling are now becoming similarly established. The House Finch is a native small bird common in the western states. Unknown numbers of the species were released in the suburbs of New York City in the 1940's. A decade ago a commonly used field guide described the species as "uncommon but increasing and spreading in the East." [38] Today the House Finch population is spreading through New England, west into the Appalachians, and south into the Carolinas. There was about a 300 percent increase of the species in the East between 1970 and 1975, an indication that the spread is now out of control. The impact of this introduction will probably not be known for several decades.

Because it is now understood that introduced species can cause serious environmental harm, the federal government has been actively attempting to prevent the spread of exotics. An example is the Fish and Wildlife Service's efforts to control the Monk Parakeet. In its native Argentina, the Monk Parakeet is a pest of millet, rice, sorghum, and citrus.[39] More than 100,000 birds of this species have been imported into this country as pets. Individuals got loose both in transit and through accidental and deliberate release by bird owners.

The species was reported breeding in the Miami area as early as 1969, but no serious efforts were made to retrieve the species in this area, where a number of exotic species have established themselves.[40] The potential spread of this bird in New York and adjoining states was taken more seriously as a threat to fruit crops in the northern states. Monk Parakeets survived several winters in the North and achieved some success with nesting before the Fish and Wildlife Service and the New York Department of Environmental Conservation undertook a successful program to remove the species from New York State.[41]

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Executive Order 11987, issued by President Carter on May 24, 1977, directs federal agencies to use their legal authority to restrict the introduction of exotic species unless it has been found that the introduction will not have an adverse effect on natural ecosystems. The order also directs agencies to encourage state and local governments and private citizens to do likewise.

RARE AND ENDANGERED SPECIES

Extinction of species is the surest way to convert a renewable living resource into a nonrenewable resource. Fossil evidence indicates that in prehuman times mammal and bird species became extinct at the rate of three per century. Since the 16th century, the extinction rate has jumped to 150 species each century. Eighty-five species or subspecies of vertebrate animals are known to have been extinguished since 1900. These greatly increased extinction rates, which are apparently associated with human activities, are evidence that nonrenewability follows disruption of natural ecosystems.

One of the reasons that certain plant and animal species become endangered is that their habitat is particularly fragile or vulnerable. Table 7–5 lists typical habitats that support endangered species. In most of them, rates of plant growth are very slow and thus recovery from any human-induced stress is also slow. Moreover, some of these habitats have no obvious appeal and may be neglected or considered expendable by most people.

Both natural phenomena and human activities that may endanger plant and animal species are summarized in Table 7–6. The effect of nature in obliterating species is of course extremely powerful; natural selection is the motivating force for the evolution of species. Yet compared with human activities which destroy species, natural processes are slow [42] and tend to create balanced complex ecosystems rather than simplified systems that are easily perturbed. However, when the effect of human activities is combined with that of natural phenomena which stress natural systems, the species that would otherwise have survived may become extinct. To avoid this situation,

Table 7-5

Common Habitats of Endangered Plant Species

Serpentine rock	Sphagnum bogs
Cedar barrens and glades	Islands
Sandy pinelands	Peninsulas
Shale barrens	Hot alkaline or salt springs
Shorelines	Canyons
Sand dunes	Vernal pools
Rocky cliffsides	Swamps
Talus slopes	Estuaries
Mountain tops	Rock outcrops

Source: Edward S. Ayensu and Robert A. DeFilipps, *Endangered and Threatened Plants of the United States* (Washington, D.C.: Smithsonian Institution and World Wildlife Fund, Inc., 1978), pp. 29–30.

Table 7-6

Natural and Human-Induced Causes of Endangerment and Rarity of Plant and Animal Species

Natural	Human
Uplift and sinking of land, including mountain ranges and islands	Construction and real estate development
Volcanic eruptions	Introduction of competitive organisms
Flooding	Off-road vehicles
Erosion	Mining
Glaciation	Forestry practices
Xerothermic periods	Biocide spraying
Droughts	Overgrazing
Expansion of deserts	Fire
Filling of lakes and ponds	Agriculture
Fire	Water management
Biotic interactions	Illegal poaching
Loss of genetic and competitive vigor	Commercial exploitation
	Collection by private individuals
	Trampling by humans

Source: Edward S. Ayensu and Robert A. DeFilipps, *Endangered and Threatened Plants of the United States* (Washington, D.C.: Smithsonian Institution and World Wildlife Fund, Inc., 1978), pp. 25, 27–28.

human beings must exercise unusual care in situations where natural forces have driven a system close to the threshold of nonrenewability.

Plant and animal species that are not listed as threatened or endangered may quickly become so if they are harvested excessively. Plants in particular are easy targets. For example, in eastern states the commercial harvest of the American ginseng is endangering this species, which supports an international trade in excess of $26 million.[43] The situation is more critical in the arid Southwest, where plant growth is many times slower than in the humid environments of the East. Desert cacti and other succulents are being subjected to intense pressure from collectors who make no attempt to allow for their recovery.[44]

Animals appear to have more spontaneous public support than plants. Yet plants provide the food for all animals (human beings included) and recirculate most of the oxygen and carbon dioxide that flow through the biosphere. There are many reasons for extreme caution in permitting the extermination of plant species.[45] For example, wild plants may have a tremendous potential for medicinal uses and as future food sources. Some examples of benefits that might be lost if too many plant species disappear are their potential as

- A food source or progenitor to new cultivars of food plants; 102 genera of proposed endangered and threatened species were used as food by American Indians.[46]
- A source of pharmaceutical chemicals that could be used for biological control of noxious organisms; for example, the molluscicide in pokeweed may help to control schistosomiasis by attacking the snail which serves as host to the parasitic fluke that causes the disease.

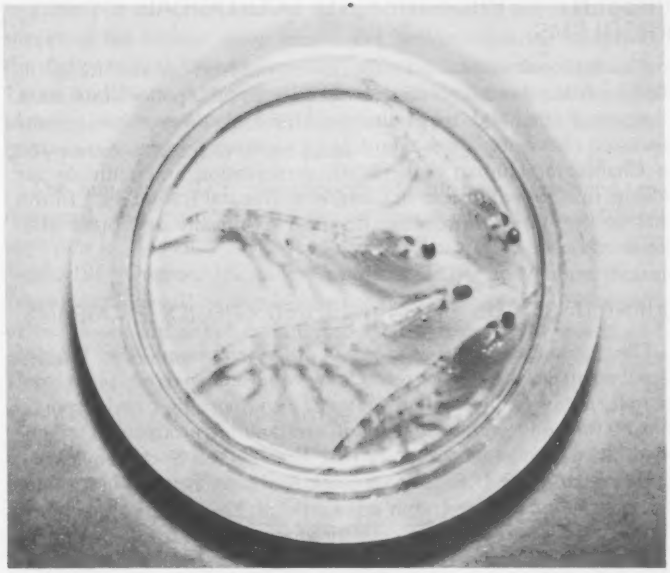
- A source of alkaloid compounds that are possibly of pharmaceutical interest for a variety of uses, including cancer control.

All these reasons refer to direct and immediate benefits to human beings and are easily understood. Equally important ecological values of these species are not so easily measured or understood. An example of the ecological value of plants is their role in mineral cycling, that is, accumulation and circulation of specific elements that are essential to the ecosystem. For instance, dogwoods accumulate calcium that is used by other plants in the same forest, and red alders fix nitrogen which is then available in the soil to other plants. Another example is the indispensable role of certain plants which are the only food source for some animal species. A good instance is the showy Mangrove Skipper Butterfly, which feeds only on leaves of red mangrove trees in south Florida. The value of many plants is thus more significant than may appear in the direct uses of their products by human beings. Even assuming that humankind could replicate the natural functions and ecological services of plants, the costs would likely be prohibitive.

OCEANS: KRILL

With the proposed development of the cold oceans of Antarctica, humankind has an opportunity to manage a rich natural resource in accordance with the principle of preserving renewability. This apparently forbidding part of the world has a plentiful bounty of marine resources. Particular attention is now being given to krill, a small crustacean that is the main food source for whales. Between 1945 and 1960, human beings killed 30,000–40,000 whales and depleted the once abundant populations.[47] The ecological void created has resulted in a surplus of krill in the oceans. Part of the krill previously eaten by whales is probably now consumed by other marine mammals which have increased their populations. Human beings are now angling for a share of the supply.

Krill is slightly larger than plankton and thus can be harvested. Although markets for this marine invertebrate have not yet been developed, plans for harvest are under consideration. Careless overharvesting might affect the Antarctic Ocean adversely; to what degree is not known. The potential for repeating past mistakes is augmented by ignorance about krill and the ecosystem of which it is a part. The rate of krill production is not known nor is its life cycle understood. How many breeding stocks there are is not known —possibly there is only one. Krill is the general link in the concentration of food in Antarctica from the tiny plankton to the larger fish and marine mammals; it is long-lived, although how long we do not know; and human consumption of krill may be at the expense of marine animal populations.



The nutrient-rich krill, a primary food source for whales and other sea creatures, are looked on as a possible food source for a hungry world.

In the plans to manage the krill harvest, it must be remembered that the size of stock is not as important as the rate of turnover. People attempting to exploit the resources of tropical wet forests have made disastrous mistakes in neglecting this principle. The large biomass of tropical trees gave rise to visions of huge profits from timber production. Yet each tree in those forests took many decades to grow, and their biomass represented over 70 percent of the nutrient reservoir of the forest. Wholesale harvesting of the tropical wet forest resulted in replacement by unproductive grassy systems, swift deterioration in fertility of the soil, and the more or less permanent loss of the magnificent rain forest. The same loss of a renewable resource could conceivably happen in Antarctica if quotas on krill are set without knowledge of its rate of growth and regeneration or without an understanding of its role in the ecosystem.

As human activities expand to new environments, particularly the cold oceans of Antarctica and the Arctic, where the krill, whales, and other marine mammals have evolved into a productive and balanced ecosystem, renewability must be kept in mind as the objective if these systems are to be harvested indefinitely. Otherwise the krill may be converted to a nonrenewable resource, as was the case with the blue whale.

PRESENT APPROACHES TO ECOLOGICAL PROBLEMS

The national response to the issues outlined in the foregoing discussion has been legislation, Executive orders, policy statements, program shifts, and expenditures. Many of these measures are discussed elsewhere in this report (e.g., wetlands protection measures in Chapter 5, Human Settlements, conservation and multiple use policies in National Forests in Chapter 6, Natural Resources). In this chapter the status of programs designed specifically to protect wildlife are discussed.

CURRENT STATUS OF ENDANGERED SPECIES PROGRAMS

The Endangered Species Act of 1973 empowers the Interior Department to list and protect rare and endangered plant and animal species in the United States. The importation and exportation of rare and endangered plant and animal products are regulated by two interagency bodies (the Endangered Species Scientific Authority and the U.S. Management Authority) established under the International Convention on Trade of Endangered Species of Fauna and Flora. Forty-four countries have ratified this Convention. The Marine Mammal Protection Act of 1972 and the Migratory Bird Treaty Act also provide protection to a number of species that are rare and endangered.

Current activities of the Department of the Interior's endangered species program include purchase of lands to protect the habitat of certain species (13,648 acres were acquired during fiscal year 1977 at a cost of $7.7 million); continued progress on the task of listing and protecting endangered plant and animal species; and intensified enforcement efforts (Table 7–7).

Table 7-7

U.S. Fish and Wildlife Service, Law Enforcement Division, Enforcement Activity 1977

	Number of criminal cases		
	Open	Closed	Pending
Migratory Bird Treaty Act	7,339	7,500	1,840
Protection of eagles [1]	390	336	172
Lacey Act	1,065	930	501
Marine Mammal Protection Act	300	292	99
Endangered Species Act and International Convention on Trade of Endangered Species of Wild Fauna and Flora	2,523	2,132	1,120
Migratory Duck Hunting Stamp Act	—	426	—
Total	11,617	11,616	3,732

[1] Bald Eagle Protection Act of 1940, Endangered Species Act of 1973, and Migratory Bird Treaty Acts.

Source: U.S. Fish and Wildlife Service.

Table 7–8 shows the current status of threatened and endangered species in the United States and in the foreign countries covered by the International Convention on Trade of Endangered Species of Fauna and Flora. Although 1,871 plant species have been identified as being endangered or threatened, so far only 17 have been officially placed on the list; all are in the United States.

The number of U.S. plant species identified as threatened, endangered, and extinct varies among states, with the most severe problems in Hawaii, 1,113; Arizona, 680; Texas, 239; Florida, 202; Utah, 194; Oregon, 182; and Nevada, 135. For the United States (excluding Hawaii), it is calculated that 2,140 species—10.7 percent of the flora—are either endangered (4.2 percent), threatened (6.1 percent), or extinct (0.4 percent).[48] In Hawaii, the situation is more critical; the estimate is that 50.6 percent of the 2,200 species of the island are either endangered, threatened, or extinct.

Table 7–8 also summarizes federal activity designed to protect endangered and threatened species.

The Endangered Species Act provides for the designation of "critical habitat" for those highly specialized habitats on which endangered species depend for survival. This designation does not necessarily involve purchase of land but does direct federal agencies to make their activities in these habitats consistent with the survival of the endangered species. The Act also provides for the establishment of "recovery teams," groups of professionals from federal, state, and local agencies and from universities assigned to the task of implementing programs for the restoration of depleted populations of endangered species. The programs are based on "recovery plans" formulated by the teams and approved by the Secretary of Interior.

Federal agencies are also required by the Act to consult with the Department of the Interior before taking any action that may affect endangered species. This requirement is at the center of the Tellico Dam controversy.

Punishment by courts		Number of civil cases	Fines and value of forfeitures (dollars)
Fines (dollars)	Probation (days)		
407,565	125,205	—	—
16,026	2,920	16	7,325
32,396	9,885	85	10,875
78	—	5	225
8,445	5,100	402	33,535
15,192	—	—	—
479,698	143,110	508	51,960

Table 7-8

Endangered and Threatened Species, their Habitats, Recovery Teams, and Cooperative Agreements with States

Category	Number of Species					
	Endangered			Threatened		
	U.S.	Foreign	Total	U.S.	Foreign	Total
Mammals	33	227	260	3	18	21
Birds	68	144	212	3	0	3
Reptiles	10	46	56	6	0	6
Amphibians	5	9	14	2	0	2
Fishes	29	10	39	12	0	12
Snails	0	1	1	0	0	0
Clams	23	2	25	0	0	0
Crustaceans	1	0	1	0	0	0
Insects	6	0	6	2	0	2
Plants	15	0	15	2	0	2
Total	190	439	629	26	10	44

Proposed animal species: 137
Proposed plant species: approximately 1,850
Proposed critical habitats: 45
Critical habitats listed: 29
Recovery teams appointed: 62
Recovery plans approved: 18
Cooperative agreements signed with states: 21

Source: U.S. Fish and Wildlife Service, *Endangered Species Technical Bulletin*, 3(7):8 (1978).

TELLICO DAM

Work on the Tellico Dam, a part of the Tennessee Valley Authority system in Tennessee, had begun when it was halted by court order on the grounds that it would destroy the last remaining habitat for the endangered Snail Darter, a small freshwater fish. The TVA had not complied with the Act's consultation requirement before beginning construction of the Dam, and the Supreme Court so indicated by upholding the ruling of the lower courts. (The Supreme Court affirmed the Court of Appeals decision; the District Court had refused to enjoin construction of the Dam.)

The reaction of some Members of Congress has been that the law is too inflexible and should be amended. However, proponents of the law's requirement point out that in 1977 the U.S. Fish and Wildlife Service engaged in more than 125 consultations with federal agencies on critical habitat and that in the 4 years since enactment of the law, about 4,500 such consultations have taken place. Only four critical habitat cases have gone to court in that time.

A critical habitat is the area of land, air, and water required by an endangered or threatened species for its survival. The Endangered Species Act [49] does not preclude all human activities in a critical habitat but charges federal agencies with the duty to make sure that

their actions do not result in destruction or modification of the habitat.[50] Advance planning, use of critical habitat maps provided by the Fish and Wildlife Service, and better understanding of the role of the species should help to avoid future conflicts in the implementation of the Endangered Species Act.

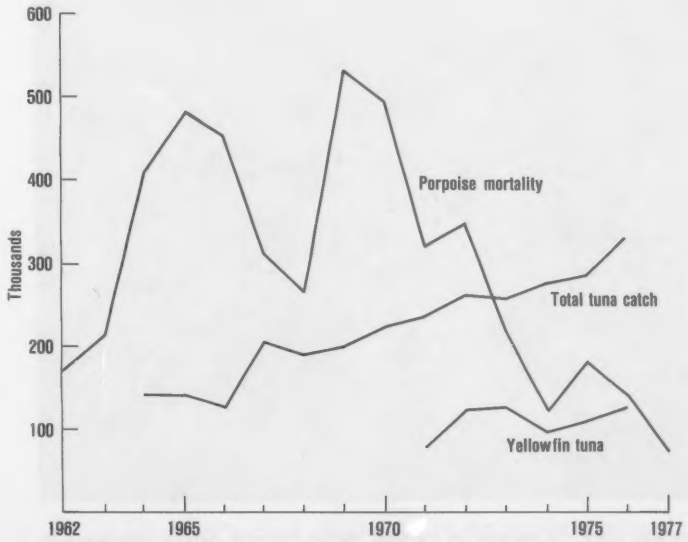
TUNA–PORPOISE ISSUE

Efforts to reduce the incidental killing of porpoises during commercial fishing for tuna have not caused any obvious sacrifice in the size of the tuna catch. The Marine Mammal Protection Act of 1972 [51] established a permit system to regulate the taking of porpoises or other marine mammals in the course of commercial fishing operations. Permit regulations issued by the National Marine Fisheries Service in May 1974 prescribed gear and fishing techniques which must be used by fishermen to minimize porpoise mortality.

NMFS observers aboard U.S. tuna vessels from 1973 to the present report that approximately 98 percent of the porpoise encircled by the nets are successfully released. Figure 7–8 shows the steady decline in porpoise mortality since 1969. Superimposed on

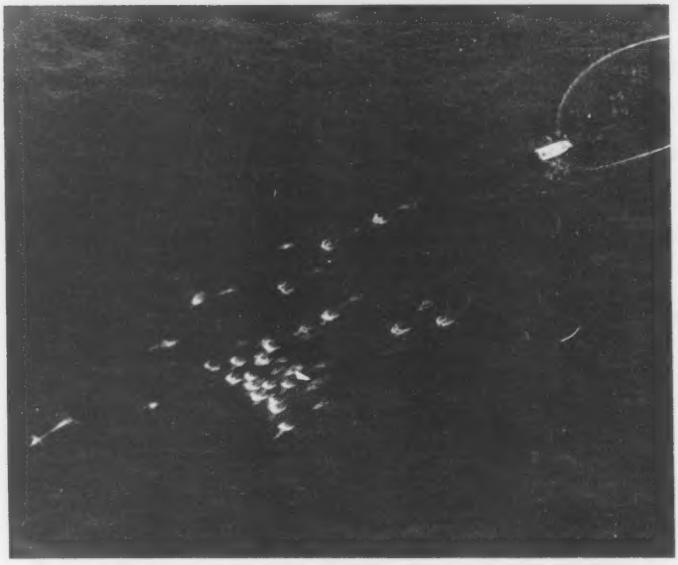
Figure 7-8

Estimated Porpoise Mortality 1962-77



Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

that curve is the tuna catch over the same years. Although it is not known how much tuna could have been caught in the absence of porpoise conservation efforts, it is obvious that porpoises are being killed at much lower levels than they were before regulations were promulgated and that the tuna catch has not declined.



"Backing down" is required by National Marine Fisheries Service regulations in an effort to reduce porpoise mortality. The results have been better than expected and commercial tuna catches have not declined.

INTERNATIONAL ASPECTS OF WILDLIFE CONSERVATION

U.S. involvement in international conservation efforts is expanding, with particular attention being given to several areas:

- Endangered species—The United States is urging the nations which are party to the Convention on International Trade in Endangered Species of Wild Fauna and Flora to implement the treaty with national laws or to sign and ratify the Convention if they have not done so already. During the past 12 months 8 countries became party to the Convention, bringing the total to 44.
- Antarctica—The Antarctic Conservation Act of 1977 remains under consideration by the congressional committees; when passed, it will implement the "Agreed Measures for the Conservation of Antarctic Fauna and Flora," an agreement among the 13 nations which are consultative parties to the Antarctic Treaty. These Agreed Measures establish certain Antarctic areas as preserves to protect Antarctic flora and fauna and prohibit the importation into Antarctica of exotic plants and animals. The National Science Foundation and the Department of the Interior are to carry out the provisions of the Measures by regulation.
- Man and the Biosphere—MAB began at the 1970 General Conference of UNESCO. It is an international interdisciplinary approach to interactions between human activities and natural systems. The United States participates in a variety of MAB activities and has designated 28 sites as part of an international network of biosphere reserves which will serve as standards to measure human impacts on the environment.
- Western Hemisphere Convention—Preparations are underway for the April 1980 Inter-American Conference on the Management of Western Hemisphere Renewable Natural Resources to be held in Washington, D.C. One of the objectives of the Conference is to develop a Pan American Migratory Species Agreement. The Organization of American States has sponsored two preparatory meetings of technical experts on marine mammals and protected areas for the preservation of ecosystems and has plans for three more on training of natural resources managers in 1978 and migratory species and legal questions in 1979.
- U.S.-U.S.S.R. Environment Agreement—During 1978 the Senate is expected to ratify the Treaty for the Conservation of Migratory Birds and their Environment signed in Moscow in November 1976. The Treaty authorizes protection of and establishes new authority to protect birds that migrate between the United States and the Soviet Union.
- Saving the Whales—U.S. efforts to save the whales continued. The United States, at President Carter's direction, has now prohibited commercial whaling within the U.S. 200-mile fishery

conservation zone, under authority of the Marine Mammal Protection Act of 1972.

- A report to the President on November 18, 1977, on the effectiveness of the International Whaling Commission conservation program stated that although IWC members are abiding by its quotas and regulations, two nonmembers (Peru and South Korea) took whales in excess of IWC quotas in 1976, and three members (Japan, Norway, and France) and one nonmember (the Federal Republic of Germany) imported whale products from nonmembers. U.S. concern over the nonmember problem has been registered through diplomatic channels and IWC resolutions. The U.S. view is that imports of whale products from nonmember nations undermine attempts to bring all whaling nations into the IWC, especially when the nonmember nations have killed whales in excess of sustainable quotas.

NEW APPROACHES TO ECOLOGICAL PROBLEMS

The laws, regulations, Executive order, and treaties described in the foregoing section have left our living resources in a far healthier state than they would have been otherwise. But despite these efforts, difficult problems remain.

Although there is sometimes reason to convert natural systems to other purposes—especially to provide renewable resources such as crops or timber on a managed basis—losses of natural values inevitably occur. These values have been summarized as follows:

- Recreational and esthetic values including both consumptive and nonconsumptive use
- Undiscovered or undeveloped values as material resources or resource substitutes
- Stabilization of natural systems
- Examples of ecological survival
- Environmental baseline and monitoring values
- Scientific research values using the plants and animals of the system for experimental purposes
- Teaching values
- Habitat reconstruction values to serve as a model for rehabilitating altered ecosystems
- Avoidance of unknown problems for further perturbing the ecosphere.[52]

Many of these values, though real and tangible, cannot easily be measured in dollars. As Aldo Leopold pointed out many years ago, "One basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value." [53] David Ehrenfeld suggests that we should get away from an economic—and anthropocentric—bias by ceasing always to regard natural systems as resources and instead regard

them as "nonresources." [54] And Charles Elton, while agreeing with most of the values listed above, suggested that one reason for maintaining natural diversity is that "it is a right relationship between man and living things." [55]

The decisions on whether to preserve natural systems and how much to preserve will always take the economic value of resources into consideration and frequently give them first place. But the intrinsic "nonresource" or noneconomic values of natural systems must also enter into the decisions.

A new philosophy of management is needed which emphasizes the goal of maintaining the renewability of our natural resources. To achieve this goal, total ecosystem management must protect the integrity of whole ecosystems. This approach, while protecting resource renewability and long-term stability, generally involves a reduction in short-term yields. Essential elements in the strategy of ecosystem management for renewability have been discussed in terms of new principles for the conservation of wild living resources.[56] These principles were developed as alternatives to the traditional maximum sustained yield concepts utilized by wildlife managers and represent an ecosystem approach to management that is worth considering here in the context of management for renewability. The four principles stated by the authors are: The ecosystem should be maintained in a desirable state such that consumptive and nonconsumptive values could be maximized on a continuing basis, present and future options are ensured, and risk of irreversible change or long-term adverse effects as a result of use is minimized; management decisions should include a safety factor to allow for the facts that knowledge is limited and institutions are imperfect; measures to conserve a wild living resource should be formulated and applied so as to avoid wasteful use of other resources; and survey or monitoring, analysis, and assessment should precede planned use and should accompany actual use of wild living resources. The results should be made available promptly for critical public review.

The conceptual advance represented by these principles rests on the fact that all the potential uses, services, or values of ecosystems are taken into consideration in management decisions. This is one step ahead of current approaches, which tend to focus on the yield of one or two species from large and complex living systems. These principles also recognize that we are still relatively ignorant about techniques needed for managing whole ecosystems. However, ignorance need not be used as an excuse for carelessness. The principles suggest the establishment of safety factors and call for minimizing waste and for monitoring, analysis, and assessment of situations in order to avoid irreversible actions, to set priorities for areas and research, and to improve our management skills. Ecosystem approaches to management of living resources are beginning to be incorporated into a number of situations.

Holt and Talbot report that the International Whaling Commis-

sion (IWC) is beginning to consider the principles described above in establishing harvest quotas.[57] At its 1974 meeting, the Commission agreed that management of whale stocks should eventually be based on some "optimum" rather than simple numerical maximum sustainable yield. The "New Management Procedures" now in effect provide for a safety factor, and the scientific analysis and assessments have been much improved, with publication required.

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CHAPTER 8

ENERGY

The nation's progress over the past year in dealing with its serious energy problem has been decidedly mixed. On the minus side, the President's Energy Plan,[1] originally submitted in April of 1977 and designed to encourage energy conservation, still had not passed the Congress in mid–1978. The House passed its version of the legislation in August 1977 and the Senate in October 1977; the joint conference committee charged with resolving the differences between the two has been unable to reach agreement on important issues such as the crude oil equalization tax. Major provisions of the legislation that had been agreed upon in the conference committee by June 1978 include the phased deregulation of natural gas; a variety of measures to encourage conservation, including tax credits for solar and conservation purchases by homeowners; steps to reform utility rate structures; and provisions for encouraging the use of coal by industry and utilities.

The need for the National Energy Plan is apparent from the cold statistics of U.S. energy supply and demand. Total U.S. energy consumption, having dipped by 5 percent between 1973 and 1975, rebounded by 7.5 percent between 1975 and 1977. The 2-year decline is probably a result partly of the large increases in energy prices following the 1973 embargo and of the economic slowdown of the mid-1970's. It is well-recognized that the nation could get along using far less energy than it now consumes with no sacrifice in standard of living; yet government efforts to reduce energy consumption in homes, auto transportation, and commercial buildings have had little effect so far. Industrial use of energy is not rising, however, despite increases in GNP.

The fact that overall energy consumption is increasing once again, with the implied need for long-term increases in oil imports, is seriously troubling. Despite the gains in domestic oil supply from Alaskan production, oil imports in 1977 were still 20 percent above those of 1976 and 45 percent above those of 1975. In the first half of 1978, oil imports were down about 10 percent from the comparable period in 1977. The decline appears to have resulted from a combination of energy conservation and increased U.S. production, mainly from the North Slope of Alaska. Nevertheless, the Depart-

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ment of Energy expects oil imports in 1979 to be above those of 1977.[2]

Nor did the prospects for using more domestic coal to replace imported oil materially improve during the past year. In its version of the National Energy Act, the Congress adopted provisions that would require substantially fewer conversions from oil and gas to coal than the President had originally proposed in the National Energy Plan. Consequently, the President's goal of reducing oil imports by increasing domestic coal consumption from the 1977 value of some 635 million tons to approximately 1.2 billion tons by 1985 may not be achieved. For every 100 million tons of coal that industry can substitute for oil, the nation can avoid importing about 1 million barrels per day of oil, reducing by about $5 billion per year our dollar outflow.

The use of coal in the United States has been limited by a lack of demand rather than supply since the turn of the century. Though cheaper than its competitors on a cost-per-British-thermal-unit basis, coal is still a dirty fuel that is difficult and dangerous to extract and inconvenient and expensive to store and burn.

The National Energy Plan directed that a review be undertaken of the possible environmental consequences of a rapid increase in coal use by 1985. In early 1978 a committee chaired by Dr. David P. Rall, Director of the National Institute of Environmental Health Sciences, reported to the President that a "safe" doubling of coal use by 1985 would require "rigorous" adherence to five principles:

- Compliance with all air, water, and solid waste regulations
- Universal adoption and successful operation of best available control technology on new facilities
- Compliance with reclamation standards
- Compliance with mine health and safety standards
- Judicious siting of coal-fired facilities.[3]

Developments of 1977 on the plus side include establishment of the Department of Energy on October 1, 1977. This action brought together for the first time the myriad agencies that regulate and research energy sources. The Department of Energy Organization Act (P.L. 95–91) consolidated the Federal Energy Administration, the Energy Research and Development Administration, the Federal Power Commission, plus many other smaller offices within a new cabinet level department.

The Department of Energy is structured along lines of major functions rather than individual technologies. The development of new technologies is the responsibility of the Assistant Secretary of Energy Technology. Similarly, there are Assistant Secretaries for Conservation and Solar Applications, Resource Applications, Policy and Evaluation, and Environment. The Assistant Secretary for Environment has responsibility to conduct environmental research and development, to provide NEPA assistance and guidance to the Department, to prepare policy and legislative EISs, to develop

DOE NEPA policies, and generally to ensure that environmental considerations are built into the Department's normal operations and decisionmaking.

Also on the plus side was the renewed interest over the role that solar technologies can play in meeting our future energy needs. CEQ and the congressional Office of Technology Assessment both issued optimistic assessments of solar technologies. Their reports, along with other solar developments, are discussed in this chapter.

Other topics covered are new developments in control of pollution from oil tankers, oil and gas activities on the outer continental shelf, coal leasing and surface mine reclamation, and important events of the year in nuclear energy.

TOWARD INCREASED ENERGY EFFICIENCY [4]

No longer is there much dispute that the United States must sharply reduce its historical rates of growth in the use of nonrenewable energy. Energy conservation—that is, deriving more goods and services from a fixed amount of primary energy by increasing the efficiency of its use—is a principal means of accomplishing this objective. Conservation lessens the need to import this energy, thus improving national security and balance of payments; provides time for widespread deployment of renewable energy technologies, principally solar; improves environmental quality; and strengthens the economy.[5]

Improvements in U.S. energy efficiency, although not inconsequential, are far short of what is needed to reduce our long-term dependence on imports—mainly oil. Recent projections by the Department of Energy indicate that total energy consumption will probably grow at less than historical rates over the next decade; yet imports are still expected to increase from 8.7 million barrels per day in 1977 to 9.1–12.5 million barrels per day in 1985 and 9.8–16.1 in 1990.[6] These projections incorporate the energy savings expected from conservation programs under existing law, which will be about the equivalent of 1 million barrels per day in 1985 and 1.7 million barrels per day in 1990. The implications of large increases in U.S. imports, for both balance of payments and international stability, point to the need for stronger measures to improve energy efficiency.

Fortunately, the technical and economic feasibility of substantial improvements over and above the conservation measures already in place is well-established.[7] The April 1978 report by the Demand and Conservation Panel of the National Research Council Committee on Nuclear and Alternative Energy Systems concludes that, given enough time to respond to prices, regulations, and incentives, U.S. energy demand could grow at a much slower rate than in the recent past and might even decline. For the year 2010, the study found that low growth energy futures could plausibly range from

consumption of 63 quadrillion Btu's per year to 137 QBtu's.* (Energy consumption in 1977 was about 76 QBtu's.) The first estimate assumes very aggressive energy conservation policies, the second a continuation of present policies. For both estimates, the Gross National Product was assumed to be about double that of 1977 (in constant dollars).

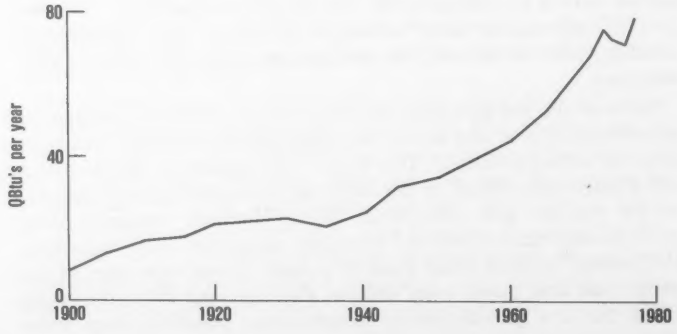
The report identified three essential factors which stand in the way of improvements in energy efficiency: price signals—current energy prices do not reflect long-run incremental costs; time—our stock of energy-using equipment is replaced only over decades; and standards and regulations—many public policies developed when energy was cheap and plentiful are still in effect but are no longer appropriate.

What follows is a brief review of progress toward more efficient use of energy in the major consuming sectors—industrial, residential-commercial, and transportation. Overall, U.S. energy consumption in 1977 was 75.8 QBtu's, 1.9 percent more than in 1976 and 1.6 percent higher than in 1973, the previous record year.[8] This growth is at a distinctly lower rate than that of the 1950's and 1960's, when energy use increased 3–4 percent per year, as shown in Figure 8–1. Compared with the earlier period, each sector showed a moderated rate of growth in 1977. Energy used by the industrial sector was 27.8 QBtu's, roughly equal to the 1976 figure. For the residential-commercial sector, energy use was 28.1 QBtu's, up 3.1 percent from the previous year, and for transportation, energy use was 19.9 QBtu's, 3.1 percent more than in 1976. Al-

* 1 QBtu = 10^{15} Btu's. Electricity is treated in terms of primary energy—that is, on the basis of the energy input to the powerplant. During the past decade, the conversion from primary to end use electrical energy was at the rate of approximately 11,500 Btu's per kilowatt hour.

Figure 8-1

U.S. Gross Energy Consumption 1900-1977



though this record suggests that the nation is beginning to respond to the challenge, progress is uneven, and additional efforts are needed if we are to enjoy the substantial benefits of more efficient energy use.

THE INDUSTRIAL SECTOR

Perhaps the clearest evidence of a genuine shift toward conservation is in industry. In 1977, the industrial sector accounted for approximately 37 percent of the nation's total energy demand, 27.8 QBtu's. Despite a 5.6 percent increase in production, energy use declined by 0.1 percent from the 1976 level. By way of comparison, industrial energy demand in the 1960's grew approximately 3.5 percent per year. The combination of increased industrial output with level energy consumption results largely from continued improvement in efficiency. The Department of Energy reported that in 1976 net energy efficiency of the top 10 industrial consumers, some 475 firms using 75 percent of total U.S. manufacturing energy, was running 8 percent above the 1972 base level.[9]

An estimate for the first half of 1977 shows continued progress; energy efficiency for the year is projected to be about 9.3 percent above the 1972 base level. The annual savings yielded by the improvement amount to about 1.4 QBtu's, which is the equivalent of 7 percent of the nation's current level of natural gas consumption, 11 percent of coal use, 44 percent of hydropower and geothermal demand, or 85 percent of nuclear power generation.

Overall, as Table 8–1 shows, the improvements to mid-1977 appear reasonably on schedule with the goals established for 1980

Table 8-1

Net Energy Efficiency Improvement in the 10 Most Energy–Consumptive Industries 1972–77

SIC	Industry	1980 Net target percentage improvement	Percentage improvement from 1972		Percentage weighted by Btu [1]
			1976	January–June 1977	
20	Food and kindred products	12	11	7	4
22	Textile mill products	22	12	10	1
26	Paper and allied products	20	9	10	8
28	Chemicals and allied products	14	10	12	26
29	Petroleum and coal products	12	10	13	21
32	Stone, clay, and glass products	16	8	11	7
33	Primary metals	9	4	2	29
34	Fabricated metals	24	8	12	1
35	Machinery, except electric	15	19	24	1
37	Transportation equipment	16	13	20	3

[1] Figures have been rounded.

Source: U.S. Department of Energy, *Annual Report*, Vol. 1, *Industrial Energy Efficiency Improvement Program*, DOE/CS–0033/1 (Washington, D.C.: U.S. Government Printing Office, 1978), p. 9.

by the Energy Policy and Conservation Act of 1975. Actual improvements have been masked in some cases because the industries are seasonal, and the first half of 1977 is not comparable with all of 1972.[10]

Table 8–2 summarizes energy improvement by the participants in the DOE Voluntary Business Energy Conservation Program as reported by trade organizations.[11] It should be noted that this voluntary reporting survey may not include some of the more energy-intensive industries that are required to report to the Department of Energy by legislative mandate. However, the data are useful in indicating variations from one industry group to another. Nearly all the industries surveyed reported some improvement, and the best was reported by the aircraft manufacturing industry (35.9 percent improvement). Other industries reporting sharp improvements include manufacturers of computer and business equipment and of farm and industrial equipment, the aerospace industry, and foundries.

Table 8-2

Percentage Improvement in Energy Efficiency by Reporting Groups

Reporting group	Percentage improvement [1]
Aerospace Industries Association of America	[2] 24.4
Air-Conditioning and Refrigeration Institute and the Commercial Refrigerator Manufacturers Association	12.4
Aluminum Association	8.5
American Bakers Association	[2] 0.8
American Boiler Manufacturers Association	14.4
American Die Casting Institute	21.4
American Feed Manufacturers Association	2.2
American Foundrymen's Society	23.1
American Iron and Steel Institute	0.9
American Meat Institute and the National Independent Meat Packers Association	[2] 20.0
American Mining Congress	0.0
American Paper Institute	[2] 10.8
American Petroleum Institute	14.4
American Textile Manufacturers Institute	9.2
Biscuit and Cracker Manufacturers Association	13.1
Brick Institute of America	21.7
Building Owners and Managers Association International	NA
Can Manufacturers Institute	7.9
Computer and Business Equipment Manufacturers Association	[2] 33.2
Construction Industry Manufacturers Association	[2] 13.1
Copper and Brass Fabricators Council	9.7
Corn Refiners Association	[2] 16.7
Expanded Shale Clay and Slate Institute	18.4
Farm and Industrial Equipment Institute	[2] 31.7
The Ferroalloys Association	(5.2)
Fertilizer Institute—fertilizer products	8.1
Fertilizer Institute—nonfertilizer products	5.8
Forging Industry Association	(*)
General Aviation Manufacturers Association	[2] 35.9
Glass—flat	21.3

Table 8-2 (continued)

Reporting group	Percentage improvement [1]
Glass Packaging Institute	9.5
Glass—pressed and blown	20.6
Grocery Manufacturers of America, Inc.	[3]7.9
Gypsum Association	[2]14.3
Manufacturing Chemists Association	[3]11.8
Metal Treating Institute	[5]6.0
Motor Vehicle Manufacturers Association of U.S., Inc.	[2]14.7
National Canners Association	5.0
National Clay Pipe Institute	6.9
National Lime Association	7.8
National Soft Drink Association	(6.2)
Pharmaceutical Manufacturers Association	([6])
Portland Cement Association	7.1
Refractories Institute	11.5
Rubber Manufacturers Association	[3]9.1
Tile Council of America	22.3
U.S. Beet Sugar Association	(30.3)
U.S. Brewers Association—brewing activities	[2]26.8
U.S. Brewers Association—malt industry	[2]7.9
U.S. Cane Sugar Refiners Association	(11.5)

NA = Not available

( ) = Negative result

[1] Expressed as the decline in this reporting period in the ratio of Btu's required to produce a given unit of output or process a given amount of material using first half of 1977 versus 1972 as a baseline.

[2] First half of 1977 versus first half of 1972.

[3] Full year ending June 30, 1977, versus 1972.

[4] The values for improvement over base year are not considered valid measurements by this industry.

[5] First half of 1977 versus second half of 1975.

[6] Joint Department of Energy-Pharmaceutical Manufacturers Association effort now underway to develop industrywide production-related energy efficiency measures.

Source: U.S. Department of Energy, *Voluntary Business Energy Conservation Program, Progress Report No. 6* (Washington, D.C.: U.S. Government Printing Office, 1978), pp. 6–7.

The reasons for these substantial gains have not been completely identified, but they may well be industry's response to increased fuel prices and its concern over availability of some fuels.

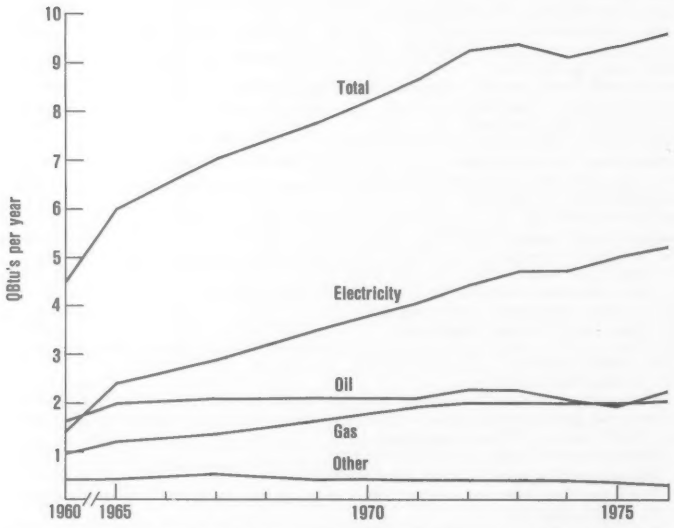
THE RESIDENTIAL AND COMMERCIAL SECTORS

The overall trend in residential and commercial energy use from 1960 to 1977 was growth. But the steady growth of more than a decade plateaued for the 3 years 1973–75 and resumed in 1976 only with revival of the economy. Aggregate levels of commercial and residential energy use reached successive new peaks in 1976 and 1977.

Residential and commercial buildings consume roughly one-third of the nation's total primary energy use for space heating and cooling, lighting, water heating, and the operation of small appliances. Between 1960 and 1972, energy use in buildings grew from 13.5 to 24.3 QBtu's at an average annual rate of 5 percent. Commercial use grew at over 6 percent per year and residential was under 5 percent (see Figures 8–2 and 8–3). (Differences in the precise

Figure 8-2

Commercial Energy Use 1960-76



Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

definition of the residential-commercial sector between the DOE Energy Information Administration and Oak Ridge National Laboratory lead to some inconsistencies. For example, EIA reports that in 1976 the sector used 27.2 QBtu's, but ORNL data shown in the two figures suggest 26.3 QBtu's. Although the absolute value differs, the trends are still significant.)

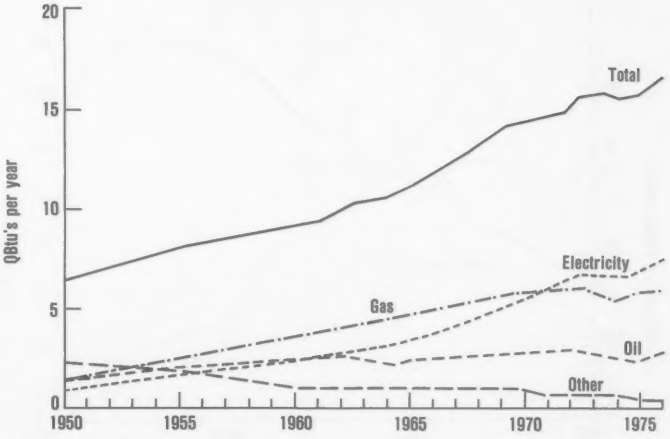
In 1973 energy use trends varied erratically from the pattern of steady increase, with no overall growth through 1975. In 1976 growth resumed at its former rate of 5 percent and continued at the same rate in 1977.

Growth trends in energy use per household and per unit of consumption in the commercial sector are somewhat more moderate. Fuel use per household, after declining from the 1972 peak, increased again in 1976 but was still about 4 percent below the 1972 level (see Figure 8–4). Preliminary data for 1977 indicate another increase. The same pattern is evident, as Figure 8–5 shows, for commercial energy use per square foot of floor space and per dollar of economic output (in constant dollars).

Changes in residential and commercial energy consumption roughly paralleled the rise and fall of economic activity, although the interruption in energy growth occurred the year before the

Figure 8-3

Residential Energy Use 1950-76



Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

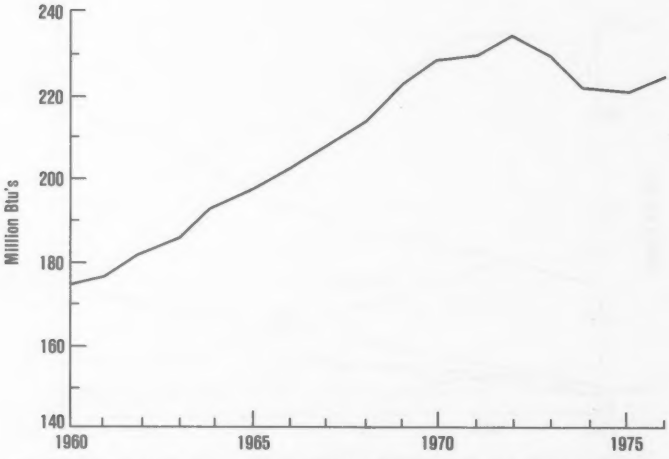
1974–75 recession. Between 1960 and 1973, real per capita income grew at an average annual rate of 3 percent. In 1974 per capita income dropped 2 percent, remained constant in 1975, and then rebounded in 1976 to the 1973 level. Per capita income increased again in 1977 by 4 percent. Similarly, real energy prices in the residential sector (corrected for inflation) began to edge upward in 1973, coincident with the leveling off of consumption. As Figure 8–6 shows, real fuel prices to residential consumers climbed markedly from the end of 1972 through 1976, with oil prices rising 65 percent above 1972 levels, natural gas 35 percent, and electricity 15 percent.

While oil and electricity prices rose sharply in the 2 years 1974–75, residential demand remained level, resuming growth only in 1976 with renewed growth in GNP and per capita incomes. The data strongly suggest that fuel use trends reflect both price changes and other economic factors.

Trends in energy expenditures per household, shown in Figure 8–7, underscore the point. Household expenditures for energy (in constant dollars) have risen steeply each year since 1970. For 1971 and 1972 the rise accompanied increased use of energy per household and steadying electricity prices, after a decade of continued price decline. Then in the next 3 years, expenditures per household continued to rise at about the same rate although the per household consumption declined. In 1976, price increases continued, but at a more moderate rate, and consumption per household again turned

Figure 8-4

Per Household Energy Use 1960-76



Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

upward. The same trends are apparent in commercial fuel expenditures.

At the same time, the mix of fuels supplying the energy shifted markedly. As Figure 8–8 indicates, electricity's share in the residential sector increased from 26 percent in 1960 to 46 percent in 1976, gas declined from 37 percent to 32 percent, oil from 26 percent to 18 percent, and other fuels—coal and liquified gases such as propane—declined from 11 percent to 4 percent. Similar shifts in fuel choice occurred in the commercial sector.

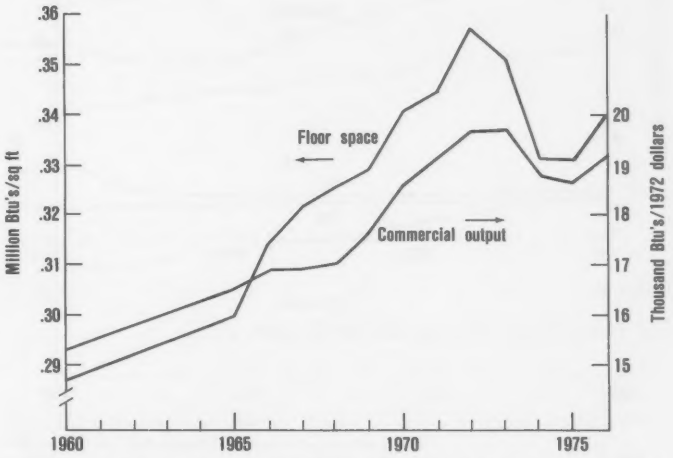
Several factors were important in the shifts: energetic marketing of electricity by utilities, public perception of gas and electricity as cleaner and more convenient than oil, population shifts away from New England, where oil is heavily used, shortages of natural gas from the early 1970's onward, and fuel price changes.

From the limited reports available, it appears that energy conservation is definitely on the rise in many individual households and commercial buildings. Industry data show that 2–3 million households added an average of 4–5 inches of attic insulation during 1974, 1975, and 1976. Preliminary 1977 reports suggest a figure of nearly 6 million. Adding 4–5 inches of attic insulation cuts space heating needs by 10–20 percent, depending on local climate and the condition of the house.

Occupants of 10 million single family detached homes (22 per-

Figure 8-5

Commercial Energy Use Relative to Floor Space and Output 1960-76



Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

cent of the applicable housing stock) took action to add energy-saving features in 1975. The average household spent $150 for attic insulation, wall insulation, storm doors, storm windows, caulking, and/or weather stripping.

The number of new heat pumps installed in homes increased rapidly from 61,000 in 1971 to 250,000 in 1976, doubling between 1975 and 1976. Heat pumps provide winter heating with approximately 60 percent of the electrical energy required by electric resistance systems. This increase in sales is particularly significant because the initial investment is several hundred dollars more than for a conventional system supplying electric resistance heat and central air conditioning.

There are many examples of individual schools, hospitals, and stores whose "housekeeping" changes have produced large energy savings. A large office building in Los Angeles, for example, cut energy use 45 percent with lower lighting levels, lower thermostat settings for winter and higher ones for summer, and improved controls on heating-cooling-ventilation systems.

It is very difficult to determine to what extent federal policies have effected these changes and how much they resulted from fuel price increases or threatened shortages. It seems likely that so far federal policies have had relatively little effect on conservation in

Figure 8-6

Average Residential Energy Prices 1960-76

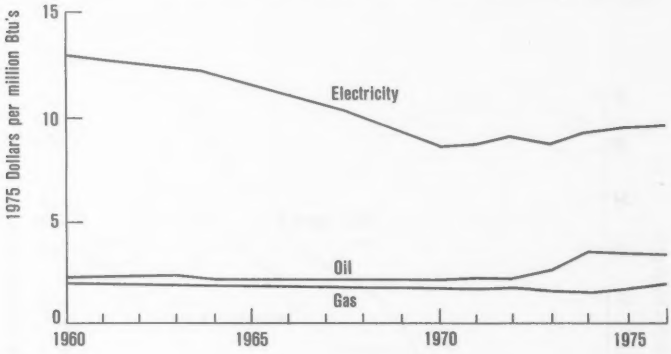
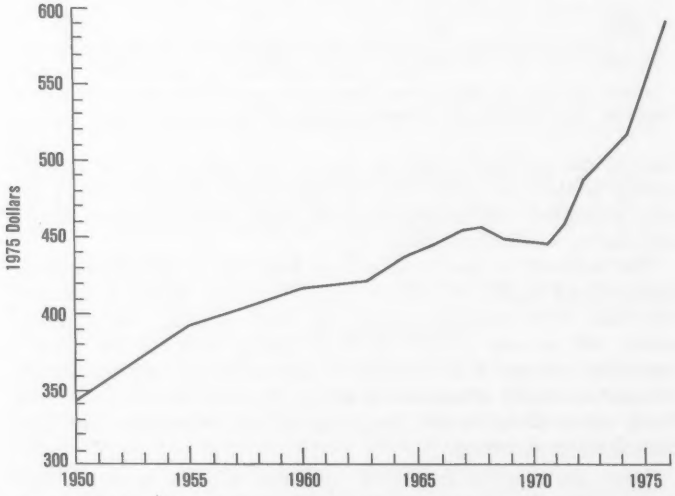


Figure 8-7

Per Household Energy Expenditures 1950-76



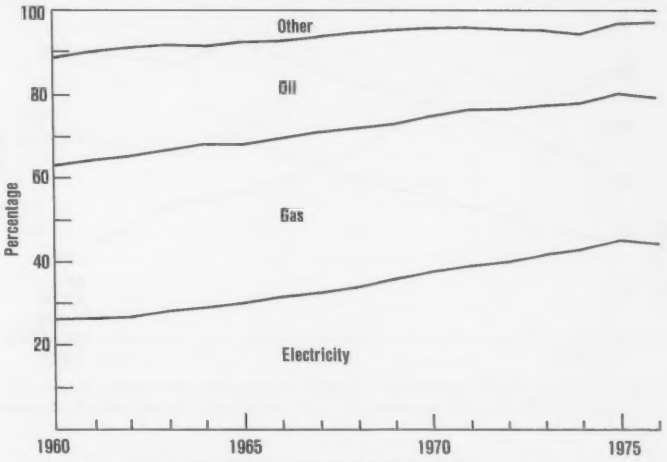
Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

buildings. An important exception is the Federal Energy Management Program, which has achieved impressive savings in the operation of federal buildings. Primarily through housekeeping changes, energy use in federal buildings dropped 20 percent between 1973 and 1975.

Federal programs may well have major impacts on energy use in buildings in the future. For example, the Department of Energy

Figure 8-8

Residential Fuel Shares 1960-76



Source: Eric Hirst and Jerry Jackson, "Recent Changes in Residential and Commercial Buildings," Oak Ridge National Laboratory, February 1978.

has set efficiency targets for appliances to be effective in 1980, and the Departments of Energy and of Housing and Urban Development are developing thermal standards for new buildings started after 1980. Other government programs are designed to provide information, encouragement, and financial incentives to owners and operators of residential and commercial buildings to upgrade existing buildings and improve the efficiency of operation.

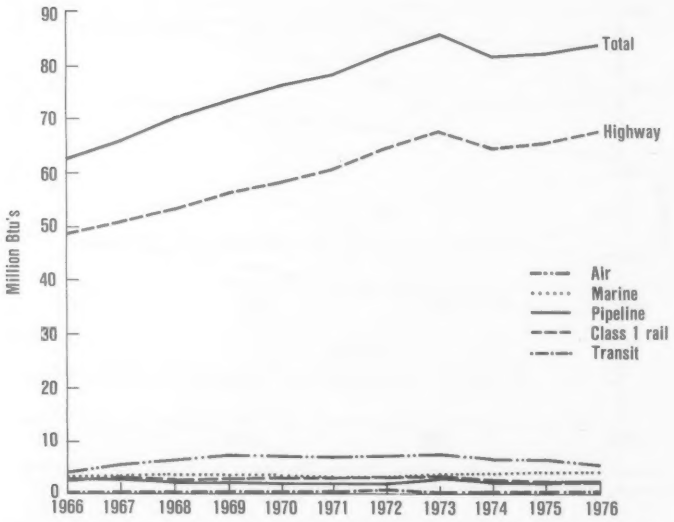
THE TRANSPORTATION SECTOR

Growth was also the outstanding trend in energy use for transportation. From 1965 through 1973 per capita consumption steadily increased at an average annual rate of more than 4 percent (see Figure 8–9). This growth paralleled that of the Gross National Product, personal disposable income, and cargo and passenger transportation. At the same time, the cost of the energy used in transportation steadily declined (in constant dollars).

Transportation maintained its share of national energy consumption over the decade, increasing slightly from 24 percent in 1966 to 26 percent in 1976. Highways continued to dominate the other four transportation modes (air, rail, marine, and pipeline) and accounted for 81 percent of transportation energy consumption in 1976. Transportation relies on petroleum to meet over 95 percent of its energy

Figure 8-9

Per Capita Energy Use by Transportation 1966-76



Source: William F. Gay, *National Transportation Statistics*, DOT-TSC-OST-77-68 (Washington, D.C.: U.S. Government Printing Office, 1977), p. 82.

demand, and the highway mode is almost exclusively dependent on petroleum.

In 1973–74 the energy use trend in transportation reversed. It declined absolutely in 1974 and barely rose in 1975. Several factors contributed to the reversal. Not only was petroleum in short supply during the oil embargo of 1973–74, but prices jumped. Simultaneously, real incomes and real GNP declined, reinforcing the negative impact of increased prices, as shown in Figures 8–10 and 8–11.

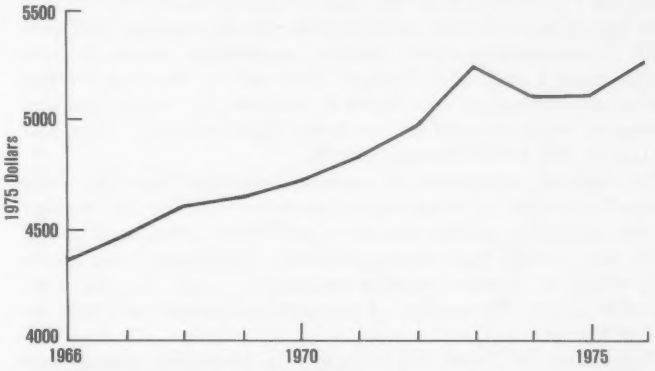
Additional impetus for reducing energy consumption came from government conservation policies and programs. Among them were speed limits of 55 miles per hour, encouragement to carpool and use public transit, and consumer education regarding new car fuel efficiency (through the DOE-EPA Fuel Economy Information Program). An important measure whose impact is only beginning to be realized is the Energy Policy and Conservation Act of 1975, which set minimum fuel economy standards for 1978 model cars at 18 miles per gallon and rising thereafter.

All these factors combined for a significant drop in energy use in transportation. But whether the decrease is transitory or it signals a trend in conservation and consumption is not yet clear.

In 1976 energy consumption for all but air and pipeline transpor-

Figure 8-10

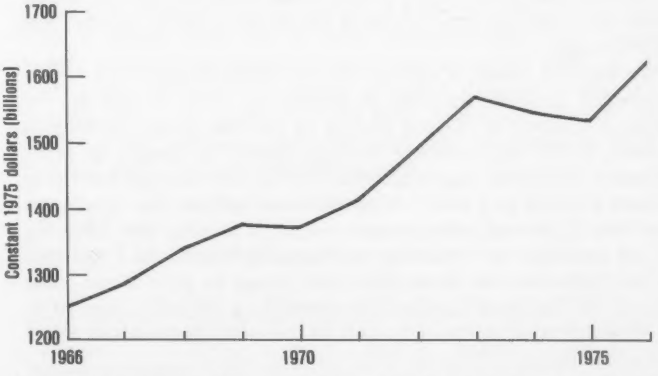
Disposable Income per Capita 1966-76



Source: U.S. Department of Commerce, Bureau of Economic Analysis, *Per Capita State Disposable Income,* annual (Washington, D.C.: U.S. Government Printing Office, 1966-75).

Figure 8-11

Gross National Product 1966-76



Source: U.S. Department of Commerce, Bureau of the Census, *Statistical Abstract of the United States 1976* (Washington, D.C.: U.S. Government Printing Office, 1976); U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business* 57(11):7 (1977).

tation rebounded to new highs. The small decline for pipelines may be attributable to a decline in the amount transported. In air, on the other hand, per capita energy use in 1976 reached its lowest level since 1967 despite increases of 10 percent over 1975 in revenue passenger miles and 5 percent in cargo ton miles for scheduled aircraft. In fact, total energy use for all air transportation was at its lowest level since 1967. Government-sponsored energy conservation measures have clearly made a significant change. They include lowering cruising speeds and eliminating some flights to increase load factors; the percentage of seats occupied on scheduled flights improved from 53.7 percent in 1975 to 55.4 percent in 1976.

For highway transportation, surveys show that consumers have adopted a number of conservation measures—reducing the number of trips, carpooling, and buying more fuel-efficient vehicles. In several cities, most notably Los Angeles, Houston, Minneapolis, and Knoxville, efforts to organize vanpools and carpools have met with considerable success. The number of vanpools has doubled each year for the last 5 years.

Nonetheless, as Figure 8–9 indicates, the immediate postembargo decline in per capita energy use in highway transportation was short lived. In fact, growth of the total transportation energy demand resumed largely because of renewed demands for highway fuel. Only the significant savings in air kept the combined per capita energy use for transportation in 1976 below the preembargo high. Preliminary data for 1977 indicate a 2.8 percent per capita increase in highway energy consumption.

An important question is whether government policies and programs have significantly affected the changing levels of energy consumed for transportation or whether most of the decline and subsequent resumption of growth can be attributed to price, income, and GNP changes.

For highway travel, it appears that economic factors were largely responsible for both the drop in demand in 1974–75 and the resurgence afterwards. Recent studies of gasoline price elasticity, a measure of the responsiveness of consumption to changes in price, indicate a surprising degree of sensitivity to price changes even over so short a period as 1 year.[12] Most estimates indicate that consumers reaot to a 20 percent price increase—which is roughly that following the oil embargo—by reducing consumption from 2 to 7 percent. If these estimates are about right, the change in price alone could account for the lower gasoline consumption in 1974–75. (For 1974, gasoline shortages in the early part of the year must also be taken into account.)

In 1976 both real disposable income and real GNP were up, as Figures 8–10 and 8–11 show. After the sharp rise in 1973–74, gasoline prices leveled off in 1975 and even declined in 1976 and 1977 (in constant dollars). As Figure 8–12 shows, gasoline prices dropped from 57.2 cents per gallon in 1975 to 55.9 cents in 1977 (constant dollars), reflecting a similar decline in the real price of imported

Figure 8-12

Price per Gallon of Regular (Leaded) Gasoline 1966-76

Source: *Platt's Oil Price Handbook 1976 Edition* (New York: McGraw-Hill, Inc.), p. 93.

crude oil. Combined with continued population growth, these factors exerted an upward force on consumption levels. Energy growth resumed despite federal efforts to promote voluntary conservation. Both highway motor fuel consumption and highway vehicle miles traveled increased 6 percent from 1975 to 1976, as Table 8–3 shows.

It is not easy to separate market behavior from voluntary conservation when the two occur simultaneously, as they did during the postembargo period. One indicator of voluntary conservation, however, is observation of the 55 miles per hour speed limit. Highway speeds dropped significantly in 1974 and remained down in 1975. During the following year, average speeds on urban interstates edged upward from 54.7 to 56 miles per hour. Speeds on rural interstate highways also increased, indicating motorists' reluctance to drive at reduced speeds for fuel economy reasons.

Table 8-3

Energy Use on Highways

	1972	1973	1974	1975	1976
Vehicle miles traveled (billions)	1,265	1,316	1,283	1,330	1,409
Highway motor fuel (million gallons)	105,062	110,473	106,301	108,984	115,700
Gasoline (million gallons)	96,543	100,636	96,505	99,354	104,978
Average miles per gallon of motor fuel	12.0	11.9	12.1	12.2	12.2

Source: U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics*, annual (Washington, D.C.: U.S. Government Printing Office, 1972–77).

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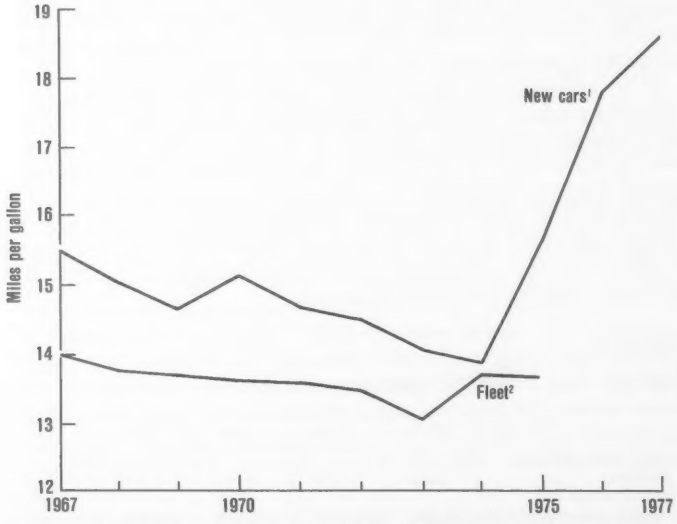
Another kind of government conservation program, which relies on changing the motor vehicles rather than their drivers, is just beginning to affect highway fuel use. Automobile and light truck efficiency standards did not officially take effect until 1978. Because these improvements affect only new vehicles and because only about 10 percent of the vehicle fleet turns over each year, efficiency gains will necessarily be gradual. Even if the fuel economy of new cars increases 15 percent in 1 year, as it did in 1976 (see Figure 8–13), the fleet average improves much more slowly. Although conservation gains from the new fuel standards so far are minor, over a decade they should be important.

Continuing energy savings in air transportation indicate that government policies to encourage conservation in regulated industries can have long-term effects. The lower cruising speeds and increased loads that are saving fuel for scheduled airlines were the result of federal action deliberately taken to conserve energy. These measures also cut industry costs.

In brief, the evidence in the transportation sector is sufficient to

Figure 8-13

Average Fuel Economy for the Automobile Fleet and New Cars 1967-77



[1]Sales-weighted city-higway combined fuel economy by model year based on post-1974 test procedures.

[2]Average miles per gallon, as reported annually by the U.S. Department of Transportation, Federal Highway Administration.

Source: D.B. Shonka, A.S. Loebl, and P.D. Patterson, *Transportation Energy Conservation Data Book Edition II*, ORNL-5320 (Oak Ridge: Oak Ridge National Laboratory, 1977), p. 185.

suggest that the dip in energy use in 1974–75 came about largely in response to price increases and economic recession and that consumption promptly rose when prices stabilized and economic growth recommenced. Exhortation by government and voluntary compliance by individual drivers appear to have had only a brief effect. However, there are indications that government requirements for energy-saving practices in regulated industries and for energy-saving construction of motor vehicles hold promise for lasting conservation effects.

SOLAR ENERGY

During the past year there has been a continued increase in public interest in the use of solar energy. For example, the National Solar Heating and Cooling Information Center, established by the Department of Housing and Urban Development in October 1976, now receives over 100,000 inquiries each year concerning the domestic use of solar heating and hot water systems.

Further evidence of public interest was the participation by millions of people worldwide in Sun Day, May 3, 1978. Inspired by Denis Hayes of the Washington-based Worldwatch Institute, Sun Day became the focus of activities in more than 1,000 cities in 36 countries and involved the participation of more than 25 million people. Events during the week of Sun Day—which fell on a Wednesday—included fairs, festivals, town meetings, workshops, tours, exhibitions of solar equipment, and numerous panel discussions on the status and benefits of solar technologies.

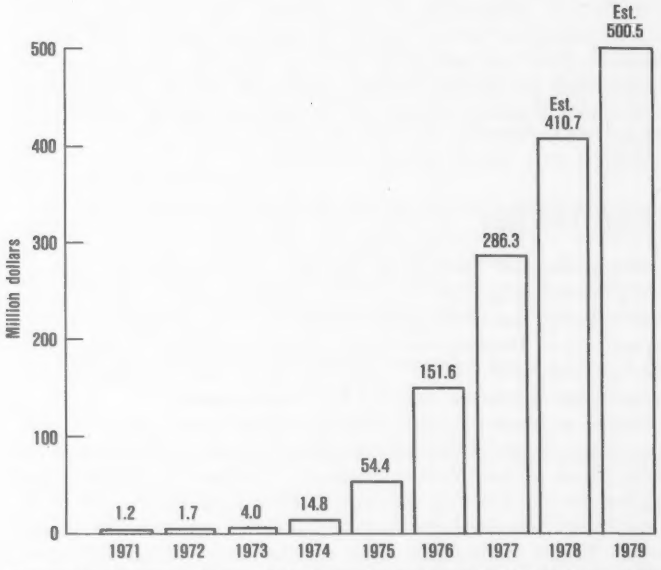
On Sun Day itself, President Carter visited the Solar Energy Research Institute in Golden, Colorado. In his speech the President referred to the recent CEQ report on solar energy, which concluded that the nation could meet as much as one-quarter of its energy demands from solar sources by the end of the century and perhaps as much as one-half by the year 2020. The President declared: "Progress toward these goals is a cornerstone of this nation's energy policy." He also directed that an additional $100 million in the Department of Energy's budget be reallocated from other lower priority programs to solar R&D (bringing the total budget commitment for fiscal year 1979 to about $600 million) and called for a cooperative national effort to hasten the application of solar technologies (see Figure 8–14).

To accelerate the federal solar effort further, the President directed the establishment of a Domestic Policy Review to begin work on development of a national solar strategy, with a September 15, 1978, deadline for completion. The specific purposes of the DPR were to provide the President with

- A sound analysis of the contribution that solar energy can make to meeting U.S. and international energy demands, both in the short and the longer term

Figure 8-14

Solar Energy Budget Growth



Source: U.S. Department of Energy, *Solar Energy: A Status Report*, DOE/ET-0062, June 1978.

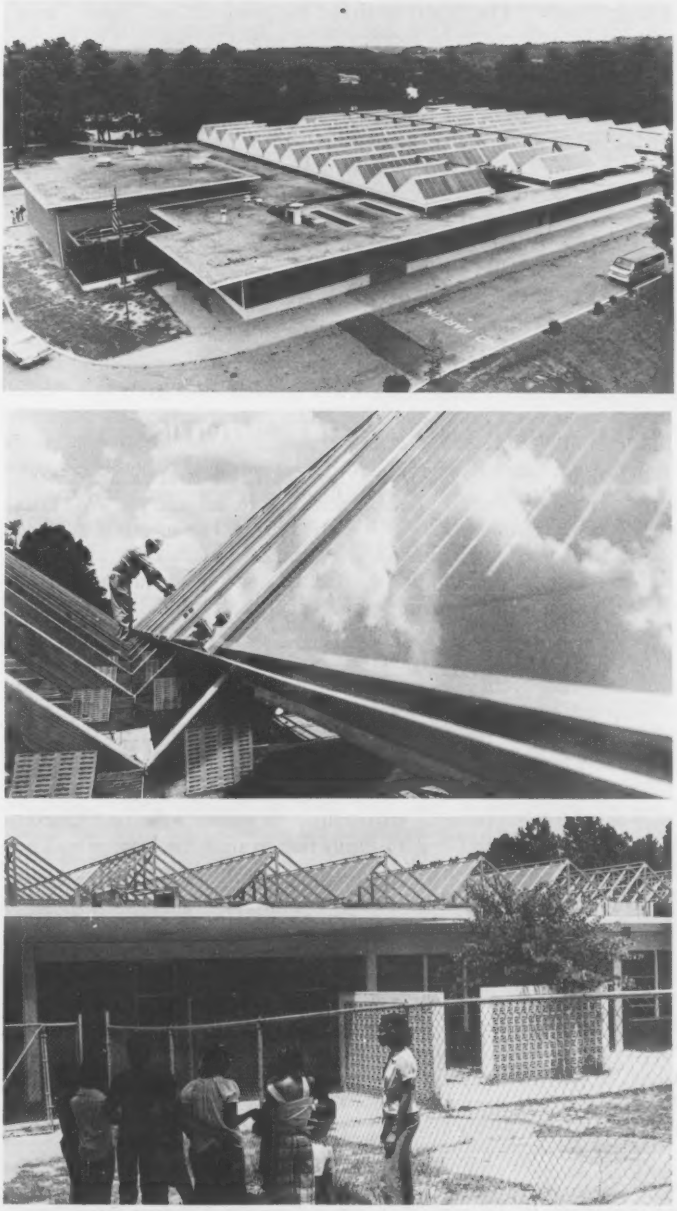
- A thorough review of the current federal solar programs to determine whether, taken as a whole, they represent an optimal program for bringing solar technologies into widespread commercial use on an accelerated timetable
- Recommendations for an overall strategy to pull together federal, state, and private efforts to accelerate the use of solar technologies.

The Council report, *Solar Energy: Progress and Promise,* was issued in April 1978.[13] It reached several basic conclusions: First, solar energy is already a serious option with some applications at or near commercial feasibility. They include passive solar heating, the burning of forest wastes for industrial use, solar hot water heating, electric power generation at existing small hydro dams, and power generation at remote sites using photovoltaic cells.

Second, if the nation today makes a strong national commitment both to accelerated solar energy use and to energy conservation, it should be possible to meet up to a quarter of its energy needs by the year 2000.

Further, for the period 2020 and beyond it is possible to speak of the United States' becoming a solar society—one in which solar is not a supplementary source but rather a primary source of energy.

Also released in 1978 was a report by the congressional Office of



The solar energy system at Atlanta's Towns Elementary School supplies more than 60 percent of the yearround heating and cooling for the building.

Technology Assessment, *Application of Solar Technology to Today's Energy Needs.*[14] The report analyzed the prospects for "onsite" solar technology designed to be located on or near the buildings or groups of buildings for which they are to provide heat or electricity. The study concluded that the technical feasibility of most direct onsite solar energy systems has been experimentally established. Moreover, by the mid-1980's, the range of costs which can be reasonably forecast for energy from onsite energy devices will overlap the range of costs forecast for conventional sources for many applications. The report concluded that with aggressive federal support, onsite solar technologies could indeed be made economically competitive in markets representing 40 percent of U.S. energy demand by the mid-1980's. The study noted that solar technologies are uniquely disadvantaged at this time because of federal programs that control fuel prices and otherwise subsidize nonsolar energy sources.

OUTER CONTINENTAL SHELF ACTIVITIES

In August 1977, Secretary of Interior Cecil Andrus announced a comprehensive revised planning schedule for oil and gas lease sales on the outer continental shelf through 1981.[15] The schedule average of five sales per year is described by Interior officials as "realistic," allowing time for consultation with states and for adequate environmental study while providing an "aggressive" OCS exploration program.[16]

An interval of about 3 years between the first sales in a frontier area and subsequent sales in the same geologic province is scheduled to help maintain a steady level of activity rather than a boom and bust cycle and to permit use of the exploratory data in selecting new tracts for sale.

The first exploratory drilling in the Atlantic OCS began in March 1978 after the Supreme Court declined to review a Second Circuit Court decision which lifted an injunction against the lease sale. The Circuit Court had reversed a District Court finding that the environmental impact statement for the mid-Atlantic lease sale was inadequate, primarily because it failed to discuss the effects of local land use controls on specific pipeline routes and landings, the potential impacts of those routes, and the impacts of alternatives such as tankers.[17] In reversing, the Circuit Court held that projection of specific pipeline routes was neither "meaningfully possible" nor "reasonably necessary under the circumstances."[18] The Circuit Court noted that impacts of pipelines would be evaluated in an EIS prepared to accompany the OCS development plan after oil and gas discoveries are made.

Meanwhile, the first lease sale scheduled for the north Atlantic was held up when the U.S. District Court for Massachusetts granted an injunction in January 1978 preventing the Georges Bank lease sale. The Conservation Law Foundation of New England, the state

of Massachusetts, and a coalition of environmental groups and sport and commercial fishermen brought the complaint. In deciding to enjoin receipt of bids for the sale, Judge Arthur Garrity said that Georges Bank is "no ordinary fishing ground" but is the source of as much as 15 percent of the world's fish protein. Observing that the Secretary of Interior has the duty under several laws of preserving the fishery resource, Judge Garrity said that it would be a violation of this duty to receive bids on the sale before the Congress passed the OCS Lands Act amendments, which would extend protection of environmental values.[19] He also found that the EIS analysis of possible impacts on the fishery was inadequate. (See the discussion of the mid-Atlantic and Georges Bank sale cases in Chapter 9, NEPA.)

Many features of the amendments requiring environmental studies and consultation with states were adopted by regulation in January 1978.[20] Oil companies holding OCS leases must include in the exploration and development plans information on the expected onshore and offshore impacts of these activities. The information must be provided to states for a 60-day review before the Interior Department approves the plans. The regulations also implemented the legal requirement that exploration and development plans must be certified as consistent with the states' approved coastal zone management plans, and they established procedures for determining whether an environmental impact statement should be prepared for development plans.[21] (See Chapter 5, Human Settlements, for further discussion of the consistency requirement.)

Both the Senate and House approved similar provisions in their amendments to the OCS Lands Act of 1953 and added the requirement that the amendments also provide for consultation with states on the overall leasing program and on the size, location, and timing of lease sales. Another important feature for protection of the environment, which appears in both bills and is supported by the Administration, is a provision for cancellation of leases. Under both bills, leases may be cancelled if there is likelihood of serious environmental damage and the advantages of cancellation outweigh those of continuing operations.[22]

The environmental studies program conducted by the Interior Department since 1974 has been intensively reviewed and is being refashioned. The program has been criticized for accumulating masses of data with too little regard for their relevance to policy decisions or to specific management questions—for example, identifying biologically sensitive times, such as breeding seasons, when oil development activities may seriously intrude.

The Department's Bureau of Land Management has also developed a program to coordinate plans for transporting OCS oil and gas. All federal agencies interested in pipeline corridors, tanker routes, and other transportation decisions will be involved in the planning, as will state and local authorities, industry, and other private groups. Regional working groups, under the cochairman-

ship of BLM and the states, will coordinate plans for each leasing area.[23]

Transportation planning is expected to be most useful for frontier areas with no previous OCS development. Here the planning effort will take place in four phases that are meshed with steps in the leasing process, from the call for nominations of tracts to be leased, through leasing, to the discovery of oil and gas, and then to the adoption of a development plan. The whole process is expected to take 4½–5 years. The planners will take into account both offshore and onshore environmental impacts of pipeline corridors and landings or tanker route and port facilities as well as safety, technical factors, and economic feasibility. Decisions will be coordinated with state coastal zone management programs (discussed in Chapter 5, Human Settlements) and other land use planning and zoning. Regional working groups for frontier areas in which leases have already been sold will be set up late in 1978.

TANKERS

NEW STANDARDS BASED ON INTERNATIONAL AGREEMENT

The Coast Guard announced a schedule for putting new international tanker standards into effect by 1979 for new ships and 1981 through 1985 for existing ships.[24] These standards were adopted at the International Conference on Tanker Safety and Pollution Prevention held in February 1978 under the auspices of the Inter-Governmental Maritime Consultative Organization (see the discussion in Chapter 11, The Global Environment).

The Coast Guard plans to withdraw the tanker rules proposed in May 1977 [25] in response to President Carter's earlier Oil Pollution Message [26] and to substitute the IMCO standards. The international agreement was a compromise. Although it falls short in several respects of the President's program and the original U.S. proposals to IMCO, its provisions are a long step forward from any current requirements.

The standards for new tankers adopted by the Conference meet most of the U.S. objectives. They also establish the important principle that both segregated ballast and crude oil washing are necessary to control routine operational discharges from crude oil tankers. Segregated ballast virtually eliminates oil discharges from deballasting because ballast water (taken aboard for return voyages after unloading) is carried in a clean separate tank system that never contains oil. Crude oil washing greatly reduces oil discharges from washing cargo tanks to control sludge buildup. Both these routine operations—deballasting and tank washing—are very important sources of oil pollution in the oceans, accounting for a much larger volume than accidental spills. (The estimate for operational pollution from tankers is approximately 1.3 million metric tons per year

worldwide, compared with 200,000 metric tons from accidents[27]; barrel for barrel of oil, however, the impact of an accidental spill may be much greater.)

The new international standards will require segregated ballast plus crude oil washing in all new crude tankers over 20,000 deadweight tons; present standards (not yet widely adopted outside the United States) require only segregated ballast for large new tankers over 70,000 deadweight tons. Inert gas systems, which help to prevent explosions in tanks containing petroleum vapors, will be mandated for all new tankers down to 20,000 deadweight tons.

Among the Conference's other positive achievements were requirements for dual radars and redundant steering controls on new and existing tankers and a recommendation for automatic collision avoidance aids, to be made mandatory after design criteria are developed. Inspection and certification standards were greatly improved. The Conference also took an important step in setting target dates of 1979–81 for ratification of the pollution and safety conventions and their amendments.

Of the several important compromises negotiated at the Conference, two affect new ships. First, segregated ballast will be required for new product tankers (carrying gasoline, diesel fuel, heavy fuel, oil, etc.) only above 30,000 deadweight tons, not 20,000 deadweight tons as proposed by the United States. The difference is not very significant to the maritime world in general, but to the United States it is. The typical recently built product tanker serving our shallow-draft ports on the east coast or the Gulf of Mexico is around 30,000 deadweight tons; new ones are likely to measure just below 30,000 deadweight tons to escape the segregated ballast requirement.

Second, there was virtually no support from other nations for the U.S. proposal for double bottoms for new tankers. The Conference adopted protective location of segregated ballast space as an alternative. IMCO committees will continue to study the question of the best location of that space based on accident experience.

Other compromises had to do with existing tankers and the size of the ship to which various requirements apply. Segregated ballast and, with a few exceptions, inert gas systems will be required for existing tankers above 40,000 deadweight tons, instead of 20,000 deadweight tons as proposed by the United States. Of 1,701 tankers calling at U.S. ports in 1976, 629 (31 percent) were between 20,000 and 40,000 deadweight tons.[28] This proportion may decline somewhat as LOOP, the deepwater port planned for the Gulf of Mexico, begins to receive crude oil shipments around 1980 or 1981, but product tankers in the smaller sizes will continue to operate in our ports.

Further, the agreements permit alternatives to segregated ballast for existing ships: crude oil washing in the case of crude tankers and clean ballast for product tankers. Crude oil washing saves substantial amounts of oil outflow and is a valuable supplement to segregated ballast, but it lacks certain advantages of segregated

ballast—intrinsic reliability and safety and air pollution benefits. Clean ballast has the disadvantage that common piping may be used for oil cargo and ballast water tanks and is thus a source of oil pollution in ballast water.

Despite these compromises, the new international standards are an important advance toward the goal of keeping oil pollution from tankers out of the world's oceans. Oil pollution is a global problem. The international agreements apply, or will apply when they are implemented, to most oil shipments in the world, not just to those entering U.S. ports. This point is especially significant for segregated ballast and other provisions to reduce operational discharges from tankers, most of which take place on the high seas.

Although the United States has not yet ratified the IMCO conventions and amendments and they are not yet in force, the Coast Guard intends to implement their provisions under the Ports and Waterways Act of 1972.[29] The IMCO agreements encourage early implementation. The Coast Guard will continue to board and examine each tanker entering U.S. waters at least once a year, noting deficiencies in a permanent record for each vessel which also records pollution incidents and accidents.

PAYING FOR SPILL DAMAGES

Among the 1977 amendments to the Federal Water Pollution Control Act [30] was an extension of U.S. authority to collect the costs of cleaning up after oil and chemical spills and to levy fines for spills of nonremovable hazardous chemicals. Section 311 of the Clean Water Act of 1977,[31] which provides that spillers must notify the Coast Guard of spills of oil or hazardous substances in harmful quantities and pay for cleanup, now covers spills in connection with OCS activity or federally licensed deepwater ports and spills which "may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States (including resources under the Fishery Conservation and Management Act of 1976)"—that is, resources in the 200-mile economic zone proclaimed under the Act.[32] Cleanup costs include those incurred by the federal government or state governments to restore or replace natural resources destroyed by an oil or chemical spill.

In 1977 the Administration submitted to the Congress a comprehensive oil pollution liability and compensation program to pay for cleaning up oil spills from any source, be it tankers, offshore oil facilities, or onshore sources, and to compensate victims for damages.[33] The scheme would replace the present hodgepodge of inconsistent state programs, federal laws of limited coverage, and slow, uncertain recourse to the common law through the courts. It would establish a no fault insurance program with limits on liability for costs and damages that are adequately high (up to $500 per ton for tanker spills, for example, or an overall limit of $50 million).

Tank trucks pump oily water from a harbor in Brittany devastated by the *Amoco Cadiz* oil spill, March 1978. Cleanup costs were expected to exceed $50 million.

A "superfund" based on the proceeds of a per-barrel tax on oil handled in U.S. ports would pay for costs and damages above the liability limits or from spills of unknown origin. Bills similar to the Administration bill were passed by the House and reported out of the Senate Committee on Commerce, Science, and Transportation by mid-1978.[34] Another bill which would add coverage for spills of hazardous chemicals to the oil liability and compensation program was under consideration by the Senate Committee on Public Works.[35]

STATE ACTIONS

Several states have taken action to protect special values in the coastal environment from possible damage due to tanker operations. Special concern for protection of Puget Sound has been expressed in a number of ways. One was Washington's law [36] banning tankers larger than 125,000 tons deadweight in Puget Sound and requiring tankers of 40,000–125,000 tons to be escorted by tugboats or to be specially equipped with double bottoms, twin screws, extra horsepower, and special radar equipment.

On March 6, 1978, the Supreme Court declared invalid all the provisions of the law relating to tanker size, construction, and equipment on the ground that they are preempted by federal law and regulations.[37] The requirement for a tug escort was allowed to stand, however, because the Court held that no federal action had been taken in this area and that tug escort is an operating rule arising from the character of local waters which call for special

precautions. On March 15 Secretary of Transportation Brock Adams issued a temporary 180-day order banning tankers over 125,000 tons from Puget Sound; he also announced that the Coast Guard is studying overall tanker operations in the Sound.[38] The public and all interested parties have been asked to advise on protecting Puget Sound from oil pollution—by limiting tanker size, controlling vessel movements, imposing speed limits, requiring tug escort, or specifying operating characteristics of vessels.[39]

California is particularly concerned about air pollution from tankers as well as oil spills. Lightering—the transfer of cargo from a supertanker to a ship small enough to enter shallow ports—is increasingly frequent in California's waters, especially in the smog-plagued Los Angeles basin. Further, California ports may receive large quantities of oil from Alaska when pipelines to transfer the oil eastward are in place.

The hydrocarbons emitted when cargo tanks of lightering ships are filled, ballast is taken aboard, or tanks are gas-freed can add to the air pollution from oxidants that is already present. Sulfur dioxide, nitrogen oxides, and particulates from their burning fuel also add to the air pollution problem.

The state has proposed a model regulation for local air pollution control districts; it requires a 95 percent reduction of hydrocarbon emissions from loading cargo tanks by 1981 and prohibits *any* emissions from nonloading operations—ballasting, gas-freeing, purging, or washing tanks. Sulfur dioxide emissions are strictly controlled. The rules would apply in California's coastal waters south of the 39th parallel and 20–80 miles offshore.[40]

The Standard Oil Company of Ohio proposes to land 500,000 barrels per day of Alaskan oil at Long Beach for delivery by pipeline to Texas. To obtain a permit for the tanker terminal, SOHIO will have to comply with strict limitations on air emissions imposed by California's Air Resources Board and follow the "emissions offset" policy of the Clean Air Act[41] (see Chapter 1, Air). SOHIO will be obliged to use best available mitigating measures on any new sources of pollution—such as tankers and storage tanks—and also to reduce emissions from existing sources.

Tankers using the SOHIO terminal would be permitted no hydrocarbon emissions; the effect is to require segregated ballast, inert gas systems, and the use of scrubbers and low sulfur fuel. One state air quality official noted during the negotiations with SOHIO over offsets that mitigating measures for tankers were the easy part; they are relatively inexpensive, available, and effective.[42]

COAL

In response to the President's request in his 1977 Environmental Message,[43] the Department of the Interior has established a comprehensive Federal Coal Management Review. The Department is

putting together a new programmatic environmental impact statement for coal development on federal lands and is analyzing the impacts of alternative leasing levels and leasing systems.

The new EIS for Interior's coal program is slated for completion in April 1979. Eight regional impact studies should also be completed early in 1979. These studies, together with assessments of coal reserves, national goals for coal production, market demands, and state and local interests, will provide a basis for deciding whether to offer new federal coal leases and, if so, at what level and where. A final decision by the Secretary on the need for new leasing and the leasing systems to use is expected in June 1979, 2 months after the EIS is completed.

Meanwhile, coal leasing on federal lands is circumscribed by court order. In September 1977 the U.S. District Court for the District of Columbia held that an earlier EIS for the coal program, completed in 1975, was inadequate because it failed to demonstrate the need for extensive new leasing and thus failed to analyze the alternative of no action.[44] The District Court noted that 26 billion tons of potentially recoverable coal on federal lands was already under lease. (This figure includes some 17 billion tons actually under lease and 9 billion subject to preference right leasing.[45]) Production from federal leases was almost 24 million tons in 1976 and 50 million in 1977.[46]

The court order was modified in June 1978 after the Interior Department and the plaintiff in the suit, the Natural Resources Defense Council, agreed to a settlement permitting leasing in a few specific situations, chiefly to maintain existing mine operations, to meet obligations under existing contracts, or to exploit coal seams which, if bypassed, would later be too expensive or environmentally damaging to mine.[47] Approximately 35 leases containing an estimated 250–300 million tons of coal may be issued under the agreement.

As part of the coal management review, the Department is scrutinizing the coal leases not now in production in order to evaluate prospects for their development in an environmentally acceptable manner. This evaluation was specifically requested in the President's 1977 Environmental Message. Of 523 leases covering 791,000 acres of federal land, 77 were producing in 1977. (There were in addition 157 applications for preference right leases, covering 434,000 acres.[48] Preference rights are ordinarily granted to anyone with a prospecting permit who has discovered a mineral deposit in "commercial quantities" or a "valuable deposit." Granting of these leases is held up pending the completion of the coal management reviews.)

The Department's intensive efforts to develop data for the review include, for example, the BLM inventory and analysis of rehabilitation potential of coal-bearing lands, the Fish and Wildlife Service research on minimizing the impacts of coal development on wildlife and habitat, and the Geological Survey assessment of coal resources and development potential. An Interior Department task force is

developing criteria to identify areas that are unsuitable for leasing. Guidelines are being developed for:

- Surface owner consent
- Endangered and threatened species
- Habitat of raptors, including bald and golden eagles
- Wetlands
- Wilderness areas
- Natural hazard lands
- Alluvial valley floors
- Historic lands and archeological areas.

Unsuitable lands will also be identified case by case by public petition. Secretary Andrus has announced the intention first to identify what lands are suitable for coal leasing, before considering indications of interest by industry.[49]

The Federal Land Policy and Management Act of 1976[50] and the Coal Leasing Amendments Act of 1975 require that coal leasing decisions be part of a comprehensive land use planning process. First-generation Management Framework Plans had been developed for approximately 80 percent of BLM-managed lands in the lower 48 states by September 1977. Priority will be given to revising the Plans for key coal regions to adapt them to a sophisticated coal leasing program.

NUCLEAR ENERGY

Efforts begun during the first year of the Carter Administration to reduce the risks of using nuclear energy have expanded. However, controversy over the use of nuclear energy has also continued and in some ways has intensified. New international and domestic initiatives were undertaken to curb the risk of nuclear proliferation and to develop an Administration policy concerning the serious and so far unresolved problem of nuclear waste disposal. Growth of the nuclear power industry continued to lag behind forecasts. Nonetheless, nuclear power accounted for nearly 12 percent of all electricity generated in the United States during 1977, with some areas of the Northeast and Midwest relying on nuclear generation for nearly one-third to one-half of their electrical needs.[51] During the first quarter of 1978, as coal supplies dwindled as a result of the nationwide coal strike, nuclear powerplants operated at capacities which exceeded their 1977 average of 65 percent.[52]

NUCLEAR NONPROLIFERATION

The Nuclear Non-Proliferation Act

On March 10, 1978, President Carter signed into law the Nuclear Non-Proliferation Act of 1978, describing it as "a major step toward

fulfillment of an objective which the United States shares with other nations—a halt in the spread of nuclear weapons capability while preserving peaceful use of nuclear energy." [53] The most comprehensive public law dealing with nuclear exports since passage of the Atomic Energy Act of 1954, the Act specifies controls, procedures, and incentives for U.S. export of nuclear technology. In addition to encouraging universal ratification of the Nuclear Non-Proliferation Treaty, the Act provides for

- Eventual application of International Atomic Energy safeguards on all nuclear activities of nonnuclear weapons countries as a condition for continued cooperation with the United States
- Immediate and future export licensing criteria for international agreements on cooperation, including maintenance of adequate physical security and U.S. consent for retransfer and reprocessing of spent nuclear fuel
- Renogotiation of all existing agreements to achieve conformity with the new criteria and conditions
- Mandatory cutoff of cooperation if a nonnuclear weapons state detonates a nuclear explosive device, terminates International Atomic Energy Agency safeguards, or materially violates a U.S. cooperation agreement.

The Act also established new procedures to minimize delays in the U.S. nuclear export process and to make U.S. export policy more predicable, including

- Override of the Nuclear Regulatory Commission on export license denials or delays if the President judges that U.S. nonproliferation objectives or common defense and security would not be jeopardized
- Time limits on executive branch consideration and NRC disposition of export license application.

Finally, the Act contains incentives for other countries to agree to U.S. safeguards:

- Joint reevaluation of all aspects of the nuclear fuel cycle with other nuclear supplier and recipient nations in the International Nuclear Fuel Cycle Evaluation
- Efforts to negotiate an International Nuclear Fuel Authority to enhance international fuel assurances and to meet concerns over handling spent fuel and disposal of wastes
- Assistance to developing countries for identifying and securing access to nonnuclear energy resources where appropriate in the interest of meeting developing country concerns for social and industrial development and reduced external dependence.[54]

INFCE

In October 1977, the United States sponsored an organizing conference of the International Nuclear Fuel Cycle Evaluation. The

INFCE, a U.S. initiative, is a 2-year technical and analytical study to find ways of making available the benefits of nuclear energy while minimizing the danger of the proliferation of nuclear weapons. Results of the INFCE will be transmitted to governments for their consideration in developing their nuclear policies and in international discussions concerning nuclear energy cooperation and related controls and safeguards.[55] More than 50 countries, the International Atomic Energy Agency, and other international organizations are participants.

In his remarks to the conference, President Carter said that the need for atomic power for peaceful uses has perhaps been greatly exaggerated and that nations should assess alternatives to nuclear power if for no other reason than economic considerations. He also called for the establishment of an international fuel bank to provide an adequate supply of nuclear fuel in case of a temporary breakdown in a bilateral supply, provided that there is both a need for the fuel and a mutually agreed upon proliferation restraint.[56] A mid-term conference of the INFCE is planned for November 1978 in Vienna.

Technological Developments

Continuing worldwide concern about nuclear proliferation has spurred interest in nuclear technology which might help meet world energy needs but at the same time make it harder to divert nuclear material for illicit use in weapons. Intense effort is going into investigation of alternatives to systems that use plutonium. Among plutonium-using systems are the liquid metal fast breeder reactor, which relies on plutonium for fuel, and the reprocessing of spent nuclear fuels to provide plutonium as a supplementary fuel for light water reactors.

Two technical developments concern the efficiency of enriching and consuming U-235, the naturally occurring fissile isotope of uranium. Both are emerging as increasingly attractive, feasible, potential alternatives to use of plutonium.

One would improve design and operation of the light water reactor, which is the system in common use in the United States. The LWR is the least efficient power reactor system in use today in uranium consumption. Improved designs could reduce the amount of uranium consumed during the lifetime of light water reactors by 15–25 percent. Use of other types of reactors, such as the Canadian CANDU heavy water reactor or advanced design heavy water and gas-cooled reactors now being developed in the United States and West Germany, could reduce uranium requirements by as much as 50 percent.[57]

More efficient uranium consumption would virtually double the amount of energy that may be produced by nuclear fission, thus postponing the need to recycle plutonium or use the breeder reactor. Use of more efficient converter reactors, which are fueled by low enriched or natural uranium not directly usable as weapons and

which discharge spent fuel that is disposed of directly or is stored under strict international controls, is referred to as an improved once-through fuel cycle. It is becoming increasingly more attractive compared to the LMFBR from both an economic and nonproliferation viewpoint. Recently, for example, nuclear researchers at Princeton University reported that a gradual evolution of fission technology—involving step-by-step adjustments to more uranium-efficient fuel cycles as uranium prices gradually rise—would appear to be more resistant to proliferation, more flexible, and more economical than development based on the plutonium breeder reactor. They believe that such systems might permit the deferral of plutonium use by as much as 100 years.[58]

A second technological development would improve the enrichment process by which the fissionable isotope U-235, which naturally occurs in uranium, is made more plentiful. Advanced isotope separation technologies such as the gas centrifuge and laser enrichment methods promise to make it much easier and faster to obtain U-235. Conventional gaseous diffusion methods originally developed during World War II deplete the U-235 content of natural uranium from 0.71 percent to 0.25 percent. Application of laser methods to remove most of the remaining U-235 from the existing inventory of tailings (uranium which has already passed through conventional diffusion plants) at U.S. enrichment plants could add almost 12 percent to world estimates of high grade uranium ore resources.[59]

A potentially serious disadvantage of these advanced enrichment technologies is that they could be misused to produce highly enriched uranium (greater than 20 percent U-235) suitable for nuclear weapons. Because highly enriched uranium is as dangerous a threat as plutonium, great caution and strong international controls will be essential for development and use of improved enrichment technologies lest they become the choice for misuse by potential proliferators.

The Clinch River Breeder Reactor

Congressional efforts to continue funding for a controversial demonstration project—the Clinch River Breeder Reactor, which is designed to use and produce plutonium as fuel—continued despite strong Presidential opposition, including a veto of the Department of Energy authorization bill for fiscal year 1978. The President said that funding of the plant would result in a large and unnecessarily costly project which, when completed, would be technically and economically unsound and would seriously inhibit the effective pursuit of an international policy to prevent the proliferation of nuclear weapons capability.[60] Efforts to reach a compromise canceling this project in favor of studies for a larger 650–900 megawatt electric design were still being made in mid-summer 1978.[61]

The Barnwell Reprocessing Plant

No way has been found to use the nuclear fuel reprocessing plant

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at Barnwell, South Carolina, to aid the U.S. nonproliferation effort. This privately owned facility has been designed to recover plutonium from reprocessed nuclear fuel. When the President recommended against further federal funding or encouragement for the plant, the Congress asked the Department of Energy to study it for possible use in support of the nonproliferation objectives of the United States. The DOE study failed to find any such use and, further, found no reason to modify the President's decision to withdraw federal support.[62] Nevertheless, at midyear the Congress was in the process of providing an additional $18 million to maintain the plant and study it further.

Plutonium Recycle

The Nuclear Regulatory Commission's proceeding on whether to allow reprocessing and widescale use of plutonium as fuel in light water nuclear reactors was halted in December 1977 when the Commission voted to end its generic proceeding on plutonium recycle (GESMO). The Administration had requested the termination in October 1977 in support of the President's nonproliferation initiatives.[63] Earlier the Administration had announced a policy to defer reprocessing and recycling of plutonium indefinitely.[64]

Spent Fuel

On October 18, 1977, the Carter Administration announced foreign and domestic policies for providing adequate and safe storage of spent nuclear fuel. The domestic policy in effect gives an additional option to U.S. nuclear powerplants, allowing them to turn spent nuclear fuel over to the federal government upon payment of a one-time fee which would cover the full costs of storage and disposal. Spent fuel from abroad could be returned and stored in the United States when it is in accord with nonproliferation interests of the United States.[65] The necessary environmental impact statements and legislation are being developed.

Nuclear Test Ban

In May, President Carter announced that the United States will seek to negotiate with the USSR and Great Britain a ban on the testing of all nuclear explosives for at least 5 years.[66] Such an agreement is one of the Administration's highest priorities in arms control and disarmament. Not only would a comprehensive test ban help slow the nuclear arms race between the United States and the USSR and help set the stage for reducing worldwide reliance on nuclear weapons, but it could also significantly support U.S. efforts to prevent the proliferation of nuclear weapons to nonnuclear weapons nations.

Although important issues such as verification and duration of a comprehensive test ban treaty remain to be resolved, the issue of use of so-called peaceful nuclear explosives came closer to resolution on

November 2, 1977, when the USSR announced that it would accept a temporary moratorium on the use of peaceful nuclear explosives if negotiation continued on how their use might be permitted in the future.[67]

Nuclear Exports: Tarapur

In April, the Nuclear Regulatory Commission deadlocked in a 2–2 vote on whether to approve the export of 7.6 tons of low enriched uranium fuel to India for use at the Tarapur power station. The dissenting Commissioners cited the failure of the Indian government to agree to place all its nuclear facilities under international safeguards as the basis for rejecting the export license. However, on April 27, 1978, pursuant to a provision of the Nuclear Non-Proliferation Act of 1978 allowing a Presidential override on such matters, President Carter approved the shipment.[68]

On June 21, the House Committee on International Relations reported a resolution recommending disapproval of the fuel shipment. The measure was defeated in a 227–181 vote by the full House of Representatives on July 12, thus ending congressional attempts to prevent the shipment.[69]

NUCLEAR WASTE MANAGEMENT

Seventy-six nuclear powerplants * have gone into operation since the nation's first commercial nuclear powerplant started up at Shippingport, Pennsylvania, 21 years ago, but many uncertainties persist regarding the safe disposal of the radioactive wastes that these plants create. Safe storage and disposal of commercial nuclear wastes have become a major national issue.

For many years, the view of the Atomic Energy Commission and later of the AEC's successor agency, the Energy Research and Development Administration, was that the basic scientific and technical information for the safe disposal of nuclear wastes was available and that a method needed only to be demonstrated. However, views on the seriousness of the waste problem appear to be changing. For example, a recent report prepared by the General Accounting Office concluded that the future of nuclear power in the United States is threatened by the unsolved radioactive waste disposal problem. The GAO report identifies social, regulatory, and geologic difficulties in the way of a solution.[70]

Reports by the American Physical Society, the California Energy Commission, and the Jet Propulsion Laboratory of the California Institute of Technology drew additional attention to the problem. The California Energy Commission found that the technology for approved permanent terminal disposal of nuclear wastes had not

* Sixty-nine nuclear powerplants are licensed in the United States at the present time.

been demonstrated and questioned whether it could be demonstrated before the mid-1980's.[71]

JPL concluded that at present the scientific feasibility of deep geologic disposal of encapsulated high level waste and reprocessed spent fuel in bedded salt has not been proven. But it found no scientific reason to anticipate that work now underway will not result in a scientific data base which will permit site selection and design.[72]

Several additional reports have raised new doubts about our ability to predict accurately the long-term stability of geological disposal sites.[73] An emerging consensus seems to be that adequate information does not now exist to allow accurate prediction of the long-term stability of nuclear waste repositories. In particular, information is lacking on the long-term interactions between the geologic media and the wastes themselves.

The public's attitude about siting of waste facilities appears to be changing from indifference to concern. Several state legislatures have now passed laws which would either require state approval of federal waste facilities or prohibit them altogether; more legislatures are considering such measures. A bill giving states the right to veto sites for waste facilities has been introduced in the Senate.

Against this background, CEQ Member Gus Speth suggested in a speech before the American Bar Association in September 1977 that an expanded commitment to nuclear power should be contingent on a satisfactory solution to the nuclear waste problem.[74] The CEQ proposal did not call for an immediate halt to licensing; it urged that a nuclear deadline be set, after which no new nuclear powerplant construction licenses would be issued unless there was a widely accepted solution, achieved after intensive public review, for safe long-term management of nuclear waste.

The proposal, which drew strong reactions both for and against from the public, the nuclear industry, and other parts of the government, was similar to measures which are already public policy in California and in Sweden.

In April 1978, the Committee on Government Operations of the House of Representatives entered the debate with a controversial report recommending that "Congress and the Executive Branch should consider requiring that further licenses for nuclear powerplant construction be conditioned upon the timely and satisfactory resolution of radioactive waste and spent nuclear fuel permanent disposal and storage problems." [75] In dissenting views, 11 of the 43 members of the Committee stated that they had found "no evidence whatsoever to justify the moratorium recommendation from either a safety, environmental or economic standpoint." [76] The report is discussed further below.

In March 1978 President Carter established a federal interagency task force on nuclear waste management. Chaired by the Department of Energy, the task force is to report to the President recommendations for comprehensive decisionmaking and implementation.[77]

The Task Force will recommend federal goals for nuclear waste management which will guide the development of workplans for the disposal of the four major types of wastes—spent fuel and high level and transuranic wastes; low level wastes; uranium mill tailings; and decontamination and decommissioning wastes.

The workplans will define a process for coordinating the necessary substantive decisions on nuclear waste management which are made by several federal agencies. They will also contribute to the Department of Energy's generic EIS on commercial nuclear waste management, to the development of legislative proposals, and to a Presidential statement of Administration policy.

There will be vigorous efforts to involve the public in shaping, reviewing, and commenting on the workplans as they develop. A discussion of the pros and cons of each workplan, with reasonable options for each and any unresolved issues requiring a Presidential decision, are to be forwarded to President Carter on September 15, 1978.[78]

NUCLEAR POWER: STATUS AND PROJECTIONS

As of February 1978, 69 reactors with a total generating capacity of more than 50 gigawatts * were in operation in the United States. Another 65 reactors with a combined capacity of 70 gigawatts had been issued construction permits and were more than 2 percent completed. Construction of an additional 21 units of 23 gigawatts capacity had been approved, but these plants were less than 2 percent completed.[79] Nevertheless, long-range U.S. nuclear power forecasts were revised downward again during the past year and the number of cancelled orders for nuclear reactors rose to 17, compared with 4 in 1976, 9 in 1975, and 14 in 1974. The Department of Energy now estimates that nuclear capacity could range from 100–122 gigawatts in 1985 and 157–192 gigawatts by 1990.[80]

As in previous years, low growth in electrical generating demand and financial difficulties continue to be the most frequently cited reasons for the declining nuclear forecasts.

NUCLEAR LICENSING

A bill designed to eliminate delays in nuclear licensing was submitted to the Congress in March by the Carter Administration. The Department of Energy estimated that the bill could cut the time lapse between the decision to build and operation of a nuclear reactor from about 10–12 years to 6–7.[81] Other studies of NRC data on delays in nuclear powerplant construction suggested that the time savings from the bill could be more modest because construction problems, financing difficulties, and labor problems have also caused significant delays.

* One gigawatt equals 1 billion watts of electricity.

The Department of Energy estimated that time would be saved mostly by reviewing potential powerplant sites early, by encouraging the use of standardized plant designs, and by allowing plant construction to begin under certain circumstances prior to Nuclear Regulatory Commission hearings. The bill would also provide public funds for intervenors on a pilot basis, allow states to assume NEPA obligations for powerplants built within their borders, and limit issues which could be raised in NRC's formal hearings if prior opportunity to raise an issue existed.[82]

The bill drew immediate opposition from environmental groups which saw it as restricting participation by the public in license proceedings. Others believed that it would limit the NRC's power to adjudicate matters arising under the National Environmental Policy Act and that under some circumstances it would allow extensive construction activity to go forward without the need for the plant in question having been specifically determined. They also objected to the provision that issues which could have been raised in a previous proceeding but were not could not be raised subsequently. The result could be to leave issues unresolved.[83] Representatives from states supported the purposes of the bill but recommended major revisions to the DOE proposal. Witnesses from industry said that reform was needed but that the DOE bill did not go far enough.

OTHER EVENTS AND TRENDS

State Regulation

By defining pollutants to include radioactive pollutants, the 1977 Amendments to the Clean Air Act gave the Environmental Protection Agency, states, and local governments a role in radiological health and safety matters.[84] The Amendments permit the states and local governments to issue regulations covering radiological releases if their regulations are more stringent than the federal rules. Federal regulation of radiological emissions, previously exercised exclusively by the Nuclear Regulatory Commission, is now the joint responsibility of the Environmental Protection Agency and the Nuclear Regulatory Commission.

Nuclear Safety

In April, the NRC formally rejected a petition to locate nuclear reactors underground sealed in a heavy vacuum containment. The NRC stated that there was not sufficient supporting material to indicate that such designs should be mandatory. The petition which had been filed in January 1977 by several public interest groups was similar to a proposal made by President Carter during his campaign.[85]

Seabrook

Controversy over construction of twin 1,150-megawatt nuclear units at Seabrook, New Hampshire, continued for the third year. If constructed, the $2.3 billion plant would be one of the largest in the United States. It has been a focus of dissension over nuclear energy since 1,414 demonstrators, led by the Clamshell Alliance, participated in nonviolent civil disobedience and were arrested there in 1977.[86]

The Seabrook construction license issue was again before the NRC because of a pair of judicial and administrative decisions. In February 1978, the Court of Appeals for the First Circuit vacated the Environmental Protection Agency's decision to permit a once-through cooling system at the plant,[87] which as planned would use 1.2 billion gallons of seawater a day.[88] In April the NRC Atomic Licensing and Safety Appeals Board ruled that the NRC Licensing Board had not given adequate consideration to alternate sites.

On June 24 and 25, the Clamshell Alliance and its supporters held a protest rally and "alternate energy" fair adjacent to the Seabrook nuclear plant construction site. With an estimated 20,000 people participating, it was the largest of U.S. antinuclear protests.[89] The controversy moved to Washington, D.C., June 28–30, when several hundred demonstrated and 56 were arrested for civil disobedience.

On June 30, the NRC Commissioners ordered construction at Seabrook suspended indefinitely in order to consider alternative sites in accordance with NEPA processes and to await a ruling by EPA on the adequacy of the plant's cooling system.[90]

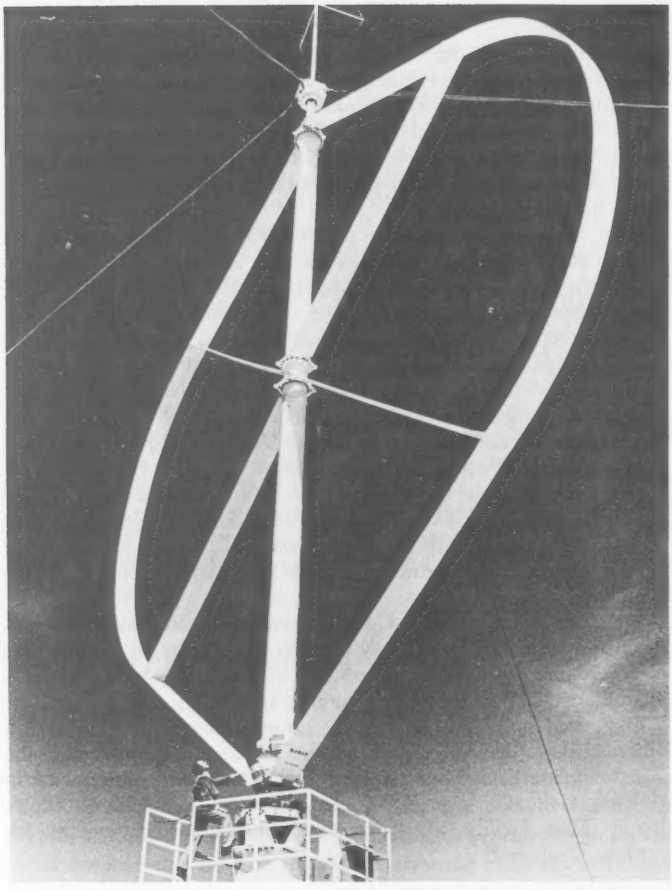
Organized opposition to nuclear power was also in evidence in other places. On May Day, nearly 1,000 people protested the Barnwell, South Carolina, nuclear fuel reprocessing plant, and in Golden, Colorado, over 5,000 demonstrators marched outside a Rocky Flats facility which produces plutonium components for nuclear weapons.[91]

Costs of Nuclear Power

A controversial report by the Environment, Energy, and Natural Resources Subcommittee of the House Committee on Government Operations found that "contrary to widespread belief, nuclear power is no longer a cheap energy source."[92] The Committee said that it may prove to be much more expensive than coal and other conventional energy sources when the still unknown costs of radioactive waste and spent nuclear fuel management, decommissioning, and perpetual care are finally included in the rate base. Further, it may well not be economical, compared with safe, renewable resource energy alternatives such as solar power.

The Price–Anderson Act[93]

The Supreme Court ruled on June 26, 1978, that the Price-



This 7-story experimental wind machine at ERDA's Sandia Laboratories in Albuquerque may prove to be a technologically and economically viable energy alternative for certain areas of the United States.

Anderson Act is constitutional.[94] The Act, originally passed by the Congress in 1957, imposes a $560 million limitation on liability for accidents resulting from operation of private nuclear plants.

The Supreme Court reversed a District Court decision that had held the Price–Anderson Act unconstitutional on the grounds that it violates due process and equal protection rights of those who live near nuclear plants and those who may be injured in nuclear accidents. The District Court had also found that the Act tends to encourage irresponsibility in matters of safety and environmental protection.

The Supreme Court found neither the Act nor the liability ceiling

to be arbitrary or irrational. The Court held that the Act provides a "fair and reasonable substitute for the uncertain recovery of damages" from a private utility in the event of a nuclear accident.[95] The Court also found that "nothing in the liability limitation provision undermines or alters in any respect the rigor and integrity" of the nuclear regulatory process.[96]

The Russian Satellite Reactor Accident

A Russian cosmos satellite, launched to provide the Soviet Union an ocean surveillance capability, prematurely reentered the earth's atmosphere over northern Canada and released approximately 100 pounds of highly enriched uranium and radioactive fission products. The radioactive contamination came from a small nuclear reactor designed to provide electric power to the spacecraft's system.[97]

A massive air search by the United States and Canada succeeded in locating only relatively small amounts of radioactive material and satellite debris which had fallen to earth. Most of the satellite is believed to have burned upon reentry and the nuclear materials widely distributed in the upper atmosphere.

Radiation

While health effects of low level radiation were receiving renewed attention, followup studies showed long-lasting impacts from radiation released by nuclear weapons testing. The Department of Energy reported that medical examinations of citizens of the Marshall Islands living on Bikini Atoll showed a 75 percent increase in their body levels of radioactive cesium in the past year. The Bikini Atoll was the site of 23 U.S. hydrogen bomb tests between 1954 and 1958. Interior Department officials said that the 139 Marshall Islanders living on Bikini would have to leave their homes within 3 months and could not return for at least 30 years because of remaining high radiation levels.[98]

An analysis of radiation effects on soldiers who participated in "Operation Smokey," an atomic bomb test conducted in August 1957,[99] showed a higher incidence of cancer than expected. Government investigations are continuing.

RADIATION HAZARDS AT LOW EXPOSURES

In the last few years a sometimes heated debate has been taking place over the potential health effects of low level radiation exposures.* A number of scientists have charged that present federal radiation standards to protect workers against excessive risks are inadequate and that permitted exposure levels should be reduced

* The controversies reviewed here center on the risks from whole body exposures from external sources of ionizing radiation. Exposures to specific organs, such as the lung, from "internal emitters" such as plutonium are beyond the scope of this review.

to 10 percent of the present values. Other scientists, both inside and outside the government, believe that no direct evidence has become available indicating that existing standards are inadequate.

The outcome of the controversy has important implications for virtually every activity involving ionizing radiation—from medical examinations to generation of electric power from nuclear reactors. In particular, if it were shown that the low level occupational exposures commonly received by nuclear workers significantly increase the risks of cancer and genetic damage, the industry would face a major task in bringing permitted exposures down to lower levels.

As often happens during such debates, the public has difficulty in evaluating the seemingly conflicting scientific evidence. Although the underlying scientific issues have not yet been resolved, it seems worthwhile to present some background on radiation, to explore the questions under debate, and to discuss some of the uncertainties in setting public health standards.

The two principal kinds of radiation of concern to public health—ionizing and nonionizing—are quite different both in origin and in their effects on living tissue.

IONIZING RADIATION

Ionizing radiation occurs naturally, from cosmic rays and in radioactive materials found in nature; it also results from human activities. For the general population, the principal exposures to ionizing radiation arising from manmade sources are from medical X-rays, radiopharmaceuticals, and fallout from nuclear weapons testing, as shown on Table 8–4. The levels of exposure listed are national averages. Nuclear workers, jet pilots (who are exposed to cosmic rays)

Table 8-4

Manmade Sources of Average Exposures to Ionizing Radiation to U.S. Population as Percentage of Naturally Occurring Background Exposures[1]

Source	Percentage
Naturally occurring background	100
Medical X-rays[2]	74
Radiopharmaceuticals[3]	16
Weapons fallout	2
Other sources (nuclear fuel cycle, jet travel, consumer products, etc.)	1

[1] Average exposures to an individual living in the United States; some individuals could receive much higher or lower exposures because of occupational sources or local natural conditions.

[2] Dose to adult bone marrow.

[3] A rough estimate of expected whole body dose by the year 1980.

Source: U.S. Environmental Protection Agency, *Radiological Quality of the Environment in the United States*, Government Printing Office, 1977).

and others exposed to radiation on the job, and people living in areas of unusually high levels of naturally occurring radioactivity may experience levels much higher than the national averages.

The fact that 800,000 people are potentially exposed to ionizing radiation on the job indicates the importance of occupational exposure.[100] The average annual dose to these workers is about twice the natural background dose (that is, about 200 millirems per year). Nearly 10 percent of exposed workers, some 79,000 people, are employed in plants that require Nuclear Regulatory Commission licenses—generally in powerplants, although nearly 11,000 are involved with fuel processing and fabrication. The average exposure for these 79,000 people in 1975 was about three times background levels (about 360 millirems per year).[101] However, some workers in the nuclear industry can have much higher whole body exposures ranging up to 90 times background exposures, as Table 8–5 shows. It is estimated that 400 nuclear workers have exposures of 50–90 times background levels.

The average occupational exposure received at nuclear powerplants has recently dropped and in 1975 was approximately eight times the average background exposure (about 800 millirems per year).[102] Approximately 75 percent of the personnel receiving exposures at powerplants are engaged in maintenance work.[103] Although their individual exposures are comparable to those of other workers in the nuclear powerplant, it would be difficult to reduce their exposures very much because of the nature of their work.

The nonoccupational exposures listed in Table 8–5 result from

Table 8-5

Selected Characteristic Individual Exposures to Ionizing Radiation as Percentage of Average Background Dose

Exposures	Percentage
Occupational (whole body exposure)[1]	
Workers in nuclear industry	
Average	360
Maximum	9,000
Jet crew	500
Nonoccupational (exposure to tracheobronchial tissues)[2]	
Living near uranium mill tailings (Salt Lake City)	Up to 1,000
Living in an area with high natural radon concentrations	400

[1] Comparison based on an average whole body exposure of 100 millirems per year.

[2] Comparison based on background exposures from naturally occurring radon to the tracheobronchial tissues of about 1,300 millirems per year. See United Nations, *Sources and Effects of Ionizing Radiation* (New York, 1977).

Source: U.S. Environmental Protection Agency, *Radiological Quality of the Environment in the United States, 1977*, EPA 520/1–77–009 (Washington, D.C.: U.S. Government Printing Office, 1977); A.C. George and A.J. Breslin, "Distribution of Ambient Radon and Radon Daughters in Residential Buildings in the New Jersey-New York Area," to be published in *Transactions of the Symposium on Natural Radiation Environment*, Vol. III (1978).

breathing radioactive radon gas and its products. This gas is present, for example, in the vicinity of radioactive mill tailings left over at uranium mills. Radon is also present in relatively large amounts in soil in some areas of the country. The exposures to lung tissue from these two sources can range up to four times or more of background exposures.

HEALTH EFFECTS OF RADIATION

There is no dispute that at high enough exposure levels radiation will cause serious biological damage. By definition, ionizing radiation has sufficient energy to ionize—that is, chemically change the structure of—cells or molecules in the body. If exposures are high enough, they can lead to acute radiation sickness and to death within hours or days. At much lower exposures, few if any biological effects are detectable. However, some of the changes caused at the molecular level can eventually lead to cancer or to genetic defects in offspring of the exposed person. The interim between exposure to ionizing radiation and the appearance of cancer, the latency period, is usually several years and may be several decades.

At low levels of exposure to ionizing radiation, acute symptoms do not occur, and identification of biological effects becomes very difficult for several reasons. First, the incidence of induced diseases is low. Identifying the risk with any statistical confidence requires analysis of a large exposed population. Second, the diseases caused by manmade radiation may have very long latency periods, they may also occur spontaneously, and they may have other environmental causes, possibly chemicals or naturally occurring background radiation. Thus to establish a causal connection with manmade radiation exposure requires data on a large exposed population and a large unexposed control group over a long time. Such studies may be possible, but they would be very costly and are difficult to carry out.

To supplement the population studies, scientists experiment with large numbers of animals, usually mice or rats. The advantages of animal studies are the ease of matching exposed and control groups and the relatively short times required. Another very important point is that many studies can be done that would not be considered for human populations. The disadvantages of animal studies are that sensitivity to specific agents can vary widely among species, making it difficult to transfer the results quantitatively to humans. Moreover, some people may be particularly sensitive to particular agents. Obviously the existence and numbers of sensitive human beings cannot be inferred from animal studies.

Because of the inadequacies inherent in both approaches, it is difficult to quantify the relationship between low level exposures to radiation and their biological effects. In developing radiation protection standards, therefore, we must make assumptions about the level of damage from low level exposure. Three approaches suggest

themselves: A *threshold* assumption (curve A in Figure 8–15) would lead to the conclusion that so long as a given threshold dose is not exceeded, the radiation damage would be completely repaired as quickly as it is produced and no harm would result. A *linear* assumption (curve B) implies that the total damage or risk is directly proportional to the total accumulated exposure. Generally the assumption is also made that the risk is the same regardless of the rate at which the dose is delivered. A third assumption is that cancer induction per total radiation dose could be *greater at low exposures* than at high exposures (curve C).

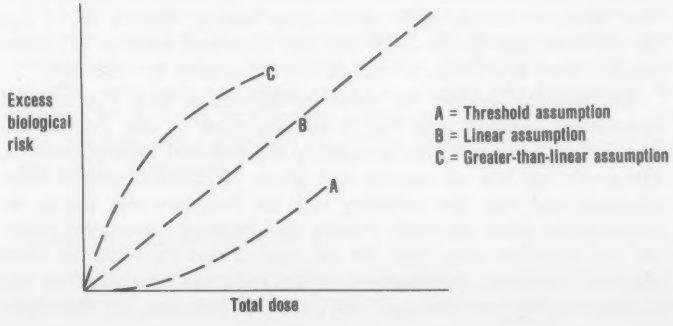
Until about 3 decades ago, most scientists concerned with radiation protection accepted the threshold hypothesis. Meanwhile, a large mass of experimental and theoretical data has accumulated, suggesting that even at low exposures to ionizing radiation, not all damaged cells are repaired or repaired correctly and some of the damage may eventually lead to cancer. For purposes of setting standards, it is now generally accepted that there is no such thing as a *safe* level of exposure, that even very low doses carry some ultimate risk of a fatal malignancy.

The linear hypothesis as the basis for radiation protection standards has been adopted by the Environmental Protection Agency, the Bureau of Radiological Health, the Nuclear Regulatory Commission, the International Commission on Radiological Protection, and the National Council on Radiation Protection and Measurements. Until recently it was generally assumed that this hypothesis would lead to conservative estimates of risk—that the average number of health effects occurring from a given amount of radiation would be less than predicted by the linear hypothesis.

Recent reports suggest that the linear theory may not be universally conservative and that for one reason or another many people may be more sensitive than indicated by the linear hypothesis to

Figure 8-15

Three Possible Relationships between Excess Biological Risk and Ionizing Radiation Doses at Low Exposure Levels



even the lowest levels of radiation. If this interpretation is correct, the present estimates of risks from low levels of radiation, based on average exposures to the population, may understate the actual hazards for large numbers of people by as much as ten times. Hearings before the Subcommittee on Health and the Environment of the House Interstate and Foreign Commerce Committee were held in early 1978 to explore this position and the federal government's response to the research which supports it.[104]

Well-known among the researchers are Dr. Thomas E. Mancuso of the University of Pittsburgh, who studied workers at the Department of Energy's Hanford Nuclear Facility in the state of Washington[105]; Dr. Irwin Bross of the Roswell Park Memorial Cancer Institute in Buffalo, who studied the effects of low-level X-rays[106]; and Dr. Thomas Najarian of the Veterans Administration Hospital in Boston, who studied the workers at the Portsmouth Naval Shipyard in New Hampshire.[107] They claim that even at very low radiation dose rates, there is a significant increased risk of cancer that is greater than had previously been suspected.

Bross and his coworkers have reanalyzed data originally gathered and published by Graham and six other scientists in the Tri-State Survey of the National Cancer Institute.[108] In the original analysis of these data, Graham found that children who were exposed to radiation in utero had a 40 percent greater probability of developing leukemia than children not so exposed. In his reanalysis of the Tri-State data, Bross reported what appears to be a relation between various diseases and radiation exposure in children's leukemia. He concluded that children between 1 and 4 years of age who have such allergies as asthma and hives have a 300–400 percent increased risk of leukemia. He also found that children who received in utero diagnostic X-ray exposure have a 50 percent increase of this risk, confirming the conclusions of Graham as well as other extensive studies by Stewart and Kneale.[109]

Dr. Bross also concluded that children who received both insults (that is, in utero exposure and allergic diseases before age 5) had a 50-fold increased risk for developing leukemia.

Dr. Mancuso reported an increase of statistical significance in several types of malignancies in workers at the Hanford Reservation. The increase was especially pronounced among workers under age 25 and over age 45. He attributed the increased number of cancer cases to very low levels of occupational exposure to radiation.

Dr. Najarian studied the death certificates of both nuclear and nonnuclear workers who had been employed at the Portsmouth Naval Shipyard. He found that among the deceased nuclear workers, the death rate for all cancers was about 75 percent greater than expected and that the mortality rate for leukemia was almost six times greater than expected. Among the deceased nonnuclear workers, the mortality rates both for all cancers and for leukemia were about as expected. Information on the radiation exposures for the nuclear workers was not made available to Najarian, but the expo-

sures are believed to have been relatively small, less than 10 rems total lifetime exposure as measured by film badges.

Over the past 2 years the scientific findings and claims of these researchers have become the subject of considerable public debate. At issue is whether federal agencies have inadequately or improperly responded to the claims of higher risks from low radiation exposures. This latter question is particularly difficult to answer because the conclusions of the studies by these researchers have themselves been challenged on scientific grounds. For example, there is some question concerning the statistical treatment of the data in the work of Mancuso, Stewart, and Kneale.[110] Specifically, although the presence of excess cancer of at least two forms seems to have been demonstrated, there is some doubt whether the very low radiation doses recorded were correctly identified as the source and whether the effects of other possible carcinogens had been adequately assessed.

The hypothesis of Bross, that there is a susceptible portion of the population (those subject to asthma, hives, etc.) with a 50-fold higher risk of leukemia, has also been challenged on methodological grounds.[111] The essence of the criticism is that Bross's methods yield no way to identify susceptible individuals ahead of time and so no way to test his thesis.

There are several major uncertainties in Najarian's analysis and his conclusion that low level radiation exposures are associated with a six-fold increase in leukemia risk. The uncertainties principally concern gaps in the information made available to Dr. Najarian during his study. For example, he had no data on the actual whole body exposures received by the workers, either routinely or accidentally, or on possible exposures from internal emitters within workers' bodies, which would not have been recorded by film badges. Nor was there any information available to him on exposures to other agents which can either cause cancer by themselves or augment the effects of radiation.

In view of the murkiness of the scientific situation, it is little wonder that public understanding of the risks of ionizing radiation is confused or limited. Unfortunately there are no simple, short-term remedies for the uncertainties. Better understanding of the effects of low level exposures will depend upon a combination of further basic biological research and carefully designed, long-term epidemiological studies. At the same time, there is little doubt that somatic and genetic risks from manmade radiation sources can and should be limited by reducing unnecessary exposures. In particular, as Table 8–4 suggests, more attention should be devoted to reducing excessive medical exposures.

NONIONIZING RADIATION

The effects on human beings of nonionizing radiation have only recently begun to attract concentrated scientific interest and are not

well understood. Nonionizing radiation is either mechanical or electromagnetic. Recent concerns over possible public health effects have focused on nonionizing electromagnetic radiation which is classified, in order of decreasing energy, as ultraviolet, visible light, infrared, microwave, and radiowave. The principal electromagnetic source is in nature; it is the sun. However, nearly all of the microwave and radiowave radiation (at the low end of the energy scale) is from manmade sources. The Environmental Protection Agency has made measurements of nonionizing radiation from manmade sources in 12 U.S. cities with a combined population of more than 38 million.

Median exposure values range from 0.005 microwatts per square centimeter in Los Angeles to approximately 0.02 microwatts per square centimeter in Boston. In each of the 12 cities studied, 98–99 percent of the population is exposed to values less than 1 microwatt per square centimeter. There are certain locations, however, where exposure values range between 10 and 300 microwatts per square centimeter, and at one location the measured power density was 2,000 microwatts per square centimeter.

What these measurements mean to public health is highly uncertain. The Soviets have adopted standards for microwave exposure; for occupational exposure, the limit is 10 for the entire workday and 1,000 microwatts per square centimeter for 20-minute exposure periods once per day; a suggested value of 1 microwatt per square centimeter for exposure of the general population appears in the Soviet literature, but it is not an all-Union standard. The U.S. occupational exposure standard is 10,000 microwatts per square centimeter, about 1,000 times the Soviet standard. Occupational exposures to microwaves can occur from radars, transmitters, power systems, industrial heat treatment systems, and many other sources. Although there is no U.S. standard for public exposures, the Bureau of Radiological Health has set a standard of 1,000 microwatts per square centimeter for microwave ovens (leakage from the door).

At high exposures, nonionizing radiation can cause major biological damage. Ultraviolet radiation can damage the eye, causing opacities and lens cataracts; it can also cause chronic skin cancer. Infrared radiation is not ordinarily a health problem except in industries where there is intense heat, for example, glassmaking. Chronic exposure to this intense infrared heat can cause lens cataracts, and prolonged exposure can result in heat exhaustion and heat stroke.

The effects of microwaves and radiofrequency radiation are also in dispute, as are those of ionizing radiation. U.S. scientists have tended to believe that the only harm possible from these long wave radiations would be from excessive heating of critical body tissues. Scientists in the Soviet Union strongly disagreed. They reported effects suggesting brain reactions, including dizziness, disturbed night sleep, moodiness, unsociability, hypochondriasis, fear, depression, headaches, and irritability. It appears, however, that most effects of

low level exposure are reversible, and their significance for human health is often unclear.

According to EPA, research is now underway to assess possible biological effects of long-term exposure to low levels of nonionizing radiation and to examine the validity of the present occupational exposure standard of 10,000 microwatts per square centimeter and the need for a general population exposure criterion. Also in question are the effects of high peak power, low average power, pulsed radiation, and the necessity for standards in the frequency range below 10 megahertz, for which there is currently no exposure standard.

As with ionizing radiation, in the absence of more complete biological information, it is prudent to reduce exposures to nonionizing radiation whenever feasible. Fortunately, the data available today suggest that probably 99 percent of the U.S. urban population is exposed to levels no higher than would be permitted even under the restrictive proposed Soviet standard of 1 microwatt per square centimeter. Available information is not sufficient to estimate the levels of exposure for the remaining 1 percent of the population. Understanding of this matter will require a detailed analysis of specific sources and a detailed knowledge of the locations of the persons exposed to such sources.

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CHAPTER 9

NEPA

NEPA REGULATIONS

The Council's proposed regulations to implement the National Environmental Policy Act were published on June 9, 1978.[1] Their purpose is to provide all federal agencies with an efficient, uniform procedure for translating the law into practical action. The new regulations are intended to accomplish three principal aims: to reduce paperwork, to reduce delays, and at the same time to produce better decisions, thereby better accomplishing the law's objective, which is to protect and enhance the quality of the human environment.

These regulations replace the Guidelines* issued by previous Councils and apply more broadly. The Guidelines assist federal agencies in carrying out NEPA's most conspicuous requirement, the preparation of environmental impact statements (EISs). The regulations emphasize the entire NEPA process from early planning through assessment and EIS preparation through provisions for followup.

Further, the regulations are uniformly applicable in the same way to all federal agencies. Each agency will have its own procedures to implement the regulations for specific programs. Our intention with these regulations is to carry out as faithfully as possible the broad purposes and spirit of the Act.

CEQ developed the new regulations in response to Executive Order 11991, issued by President Carter in 1977. He directed that the regulations should be

> designed to make the environmental impact statement process more useful to decisionmakers and the public and to reduce paperwork and the accumulation of extraneous background data, in order to emphasize the need to focus on real environmental issues and alternatives.[2]

The Council attempted to meet all three objectives—better decisions, less paperwork, and less delay—in major provisions of the regulations.

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* The Guidelines (40 C.F.R. Part 1500) will remain applicable until the effective date of the Council's regulations. The effective date of the regulations is eight months after their final publication in the *Federal Register*.

BETTER DECISIONS

Sound decisions reflecting good environmental analysis and understanding are the goal of the NEPA process. The EIS and other "action-forcing" procedures required by the law are a means to this end.

A principal theme of the NEPA regulations is that decisions will be improved if agencies concentrate on the important issues and trim away masses of background data that obscure the real choices. EISs, the regulations say, should be "analytic, not encyclopedic," and analysis of alternatives, "the heart of the environmental impact statement," should be emphasized.

The regulations establish a new procedure called "scoping" to ensure that the important issues are selected for attention from the beginning. Scoping is to take place as early as possible in the NEPA process, in most cases soon after the decision to prepare an EIS. Besides identification of the central issues, a purpose of scoping is to ensure that environmental review is integrated with other planning at an early stage—not tacked on at the end of the planning process, with the EIS written to justify a decision that has already been made.

At the time of decision on an action, the agency must prepare a concise public record, stating what the decision is and how the EIS was considered and used. If the environmentally preferred alternative was not chosen, the record must state what other considerations of national policy led to the choice. The purpose is to ensure that decisionmakers take a close look at what is best for the environment, making it more likely that decisions will reflect a sensitivity to environmental values.

The record of decision must also include a summary of measures adopted to mitigate environmental damage caused by the action or of reasons for not adopting them. One way to implement mitigation measures is to attach conditions to federal permits. Agencies must also monitor mitigation measures and keep the public informed on how they are working.

The regulations strongly advocate writing in plain, direct language. They require accurate documents as the basis for sound decisions. The documents should draw upon all the appropriate disciplines from the natural and social sciences, plus the environmental design arts. The lead agency is responsible for the professional integrity of reports, and care must be taken to keep out of the environmental analysis any possible bias from data prepared by applicants. The names of individuals who helped prepare documents and their qualifications will be included in the EIS. Agencies must designate a person who is responsible for overall compliance with the broad purposes of NEPA and must have enough staff and resources to integrate environmental analysis into the agency's plans and decisions.

REDUCING PAPERWORK

An effective way to reduce needless paperwork is to cut down on the size of EISs, keeping them concise and to the point. In the past, some multivolume EISs have exceeded 1,000 pages, in one instance running to 17 volumes, over 9,600 pages, and 2 feet of paper. The Council's draft regulations recommend that future EISs should not usually exceed 150 pages or, for complex proposals, 300 pages.

By identifying the important issues, the "scoping" process will help to narrow the number of issues treated in the EIS and hold down peripheral matters. The length of the EIS can be discussed during scoping. The regulations explicitly direct that EISs not contain extensive background material that is not useful to decisionmakers and the public. Material may simply be incorporated by reference if it can be done without sacrifice to agency and public review.

The regulations demand that EISs follow a clear format which will avoid repetition. Short summaries, usually less than 15 pages, will identify areas of controversy, alternatives, and major conclusions. When an EIS is unusually long, the summary may be circulated instead to most reviewers, and the full document would go to selected agencies and individuals with a particular interest in the proposal.

To eliminate duplication, the regulations provide for federal agencies to prepare EISs jointly with state and local units of government which have "little NEPA" requirements. They also allow a federal agency to adopt an EIS prepared by another agency rather than starting from scratch on an analysis that has already been adequately done.

REDUCING DELAY

Several major provisions of the regulations are expected to reduce delays related to NEPA obligations. Integrating the NEPA review early in the planning of actions means less delay at later stages. Making the NEPA review concurrent with other environmental reviews and consultations eliminates the duplication inherent in separate procedures.

The regulations emphasize timely cooperation among federal agencies in drafting the EIS rather than unnecessarily late criticism of a completed draft, which tends to prolong the EIS process.

The regulations also provide for prompt selection of a lead agency to take primary responsibility for preparing the EIS and of cooperating agencies to contribute to it. They direct agencies to make an early start on EISs—as near as possible to the time the proposal is made.

The regulations allow agencies to set time limits on the NEPA process, particularly when private applicants have a strong interest in early federal action. When applicants request time limits, agencies

must set them, so long as they are consistent with NEPA and other national policy considerations.

Joint preparation of EISs by federal, state, and local agencies means that a new project will not undergo several time-consuming environmental reviews when one would suffice. Adopting another agency's EIS can also save time as well as paperwork.

CLARIFICATIONS

The Council's NEPA regulations are not only broader than the guidelines that they are intended to replace, but they also clarify how NEPA applies in situations which have been handled differently by different agencies in the past. The variation in agency practice was confusing to local officials and private citizens, especially applicants for federal permits or funds. The regulations, which are binding, establish a basic uniform approach and set down clearly what it is to be.

For the essential decision on whether to prepare an EIS, the regulations outline a process for each agency to follow in its own procedures, which implement the regulations. First, the agency defines actions that do not—individually or cumulatively—have a significant effect on the human environment and therefore normally do not require either an environmental assessment or an EIS. These are referred to as "categorical exclusions."

Agency procedures must also define actions that normally *do* require an EIS, plus actions that normally require an environmental assessment but not necessarily an EIS. The environmental assessment is used when the agency does not know beforehand whether the proposed action significantly affects the environment. The assessment briefly discusses the need for the proposal, alternatives to it, and environmental impacts of the proposal and the alternatives. The assessment may also help the agency comply with NEPA when no EIS is necessary, or it may contribute to preparation of the EIS when one is necessary.

If the agency determines on the basis of the assessment that a proposed action will have no significant effects on the environment, it makes a finding of no significant impact. Both this finding and the environmental assessment are publicly reviewable documents. If there are significant effects, the agency files a notice of intent to prepare an EIS and thus begins the EIS process.

The scoping process is a major innovation of the draft regulations and is a key procedure for accomplishing their goals. It brings together all parties with an interest in the proposal, including its opponents, in the effort to achieve an early consensus on what is really significant about the proposal and what is not. It begins when the lead agency publishes in the *Federal Register* a notice of intent to prepare an EIS. Affected federal, state, and local agencies and interested members of the public must be invited to participate. When practicable, a scoping meeting is held. Besides settling on the

major issues to be considered, the scoping process determines the length of an EIS, the time for preparation, and allocation of responsibility among agencies.

The regulations distinguish between lead agencies, which have primary responsibility for the action, and cooperating agencies, which have jurisdiction by law or have special expertise on the subject. Cooperating agencies are given an early and active role, to improve the environmental analysis and to minimize delays and eliminate unnecessary conflicts among agencies. If agencies differ on which should take the lead in preparing an EIS or if none is willing to to take the lead, the regulations provide a means for prompt resolution of the dispute.

To eliminate repetitive discussions of the same issues and to focus on issues which should be considered at each level of environmental review, the regulations encourage tiering of EISs. Material common to many actions may be covered in a broad EIS and may then be summarized and incorporated by reference in subsequent EISs rather than reiterated in each.

The regulations delineate procedures for public involvement throughout the NEPA process, including the specific means by which agencies shall provide public notice of NEPA-related hearings, meetings, and availability of environmental documents. Agencies have the duty to solicit comments on EISs from interested members of the public, including those who might oppose the action.

The regulations tighten the rules on assistance that interested applicants for federal permits or licenses may give agencies preparing environmental documents. Although applicants may contribute information for the environmental assessment, agencies must take responsibility for its scope and content and make their own evaluations. Agencies must prepare the EISs themselves or select contractors to do them. Contractors must sign disclosure statements saying that they have no financial interest in the outcome of the project.

While the NEPA review is going on, agencies may not take any action on the proposal under review which would damage the environment or limit the choice of alternatives. If a private applicant plans to take action of this kind, the applicant should be warned—that is, informed by the agency that it will take action to safeguard the objectives and procedures of NEPA.

The regulations spell out detailed procedures for referring to the Council disagreements among agencies over proposed major federal actions that may have environmentally unsatisfactory effects and that warrant national attention. These procedures cover environmental referrals by the EPA Administrator under Section 309 of the Clean Air Act [3] and referrals by other federal agencies as a result of their review of and comment on draft EISs. Means are provided for early resolution of disagreement.

An abbreviated EIS process for legislative proposals is established.

Except in specified situations, no final EIS is required for legislative statements. The period for public review of a legislative EIS may be shortened in order to coordinate with Congressional hearings on the proposal.

The regulations define federal actions comprehensively to include actions with major effects which are potentially subject to federal control and responsibility. Such actions include new and ongoing programs and projects, the adoption of regulations and plans, and the approval or financing of specific projects.

Recognizing that federal agencies have different kinds of activities subject to NEPA, the regulations require each agency to adopt supplemental procedures detailing how its actions will be tailored to fit the new governmentwide regulations. These supplemental procedures are subject to Council review and must be adopted within 8 months after the Council promulgates its final regulations.

It should be noted that the issue of application of NEPA to environmental effects occurring outside the United States is addressed in the regulations. The President has announced his intention to issue an Executive order which will govern how and when federal agencies must prepare environmental review documents for major federal actions having effects on the environment outside the United States.

BACKGROUND

In developing the draft regulations, CEQ was greatly assisted by the hundreds of people who responded to the call for suggestions on how to make the NEPA process work better. In the hearings held in June 1977, testimony was invited from public officials, organizations, and private citizens.

Among those represented were the U.S. Chamber of Commerce, which coordinated testimony from business; the Building and Construction Trades Department of the AFL-CIO, for labor; the National Conference of State Legislatures, for state and local governments; and the Natural Resources Defense Council, for environmental groups. Scientists, scholars, and the general public also participated.

These diverse witnesses expressed the unanimous view that NEPA benefited the public. Equally widely shared was the judgment that the process had become needlessly cumbersome and should be streamlined.

Witness after witness said that the length and detail of EISs made it extremely difficult to distinguish the important from the trivial. We then prepared a questionnaire based upon the hearings and sent it to all witnesses, all state Governors, all federal agencies, and everyone who responded to an invitation in the *Federal Register*. Comments received from more than 300 respondents were useful in drafting the regulations.

CEQ also met with every federal agency to discuss what should be in the regulations. Guided by these interactions with government

agencies and the public, draft regulations were prepared and circulated for comment to all federal agencies in December 1977. To improve this draft, we studied agency comments in detail and consulted numerous federal officials with special experience in implementing the Act. Informal redrafts were circulated to the agencies with the most experience in preparing environmental impact statements.

At the same time that federal agencies were reviewing the early draft, CEQ continued to meet with members of the public, including representatives of business, labor, state and local governments, and environmental groups.

Also included in the regulations is virtually every major recommendation made by the Commission on Federal Paperwork [4] and the General Accounting Office [5] in their recent studies on the environmental impact statement process. The studies by these two independent bodies were among the most detailed and informed reviews of the paperwork abuses of the impact statement process. In many cases, such as streamlining intergovernmental coordination, the proposed regulations go further than their recommendations. The draft regulations published in June reflect the year-long process of hearings, consultations, and reviews.

NEPA COURT CASES

The only Supreme Court opinion to address agency responsibilities under NEPA in the past year was *Vermont Yankee Nuclear Power Corp.* v. *National Resources Defense Council.*[6] In two consolidated cases involving NEPA's application to the construction and licensing of nuclear powerplants, the Court upheld the Nuclear Regulatory Commission's informal rulemaking procedures for determining the environmental effects of fuel reprocessing. In reversing an opinion by the D.C. Circuit Court of Appeals, the Court held that the Commission's rulemaking process met the minimum procedural requirements of the Administrative Procedure Act and NEPA. The Court also held that NEPA did not require additional procedures beyond those specified in the APA.

In the companion case, the Supreme Court also disagreed with the D.C. Circuit Court of Appeals, which had held that an EIS prepared by the Commission during 1971-72 was obliged to consider energy conservation as an alternative to nuclear power although the significance of that alternative was not raised in comments by intervenors in the licensing proceeding.[7] The Court noted that when the EIS was prepared, "energy conservation" was an emerging concept which involved an almost limitless range of possible actions that might reduce projected demands for electricity from a particular proposed plant. The Court also noted that the intervenors in the case had raised the question of energy conservation generally but had not indicated its significance to the decision before the

Commission of whether to permit construction of a particular nuclear powerplant. The Court said that the Commission was reasonable in requiring intervenors to specify the significance of the issue before assuming an obligation to consider it.

In support of its decision, the Court considered the CEQ 1971 Interim Guidelines (referred to in the opinion as regulations) which were in effect when the EIS was prepared.[8] Explicit mention of energy conservation as a reasonable alternative to be considered in the EIS did not appear in the Interim Guidelines but was added in the amended Guidelines of August 1973.[9]

Speaking generally about NEPA, the Court noted:

> NEPA does set forth significant substantive goals for the Nation, but its mandate to the agencies is essentially procedural. It is to insure a fully informed and well considered decision, not necessarily a decision the judges of the Court of Appeals or of this Court would have reached had they been members of the decision-making unit of the agency. Administrative decisions should be set aside in this context, as in every other, only for substantial procedural or substantive reasons as mandated by statute.[10]

The Court's broad characterization of NEPA emphasizes the principle of administrative law that the courts ordinarily do not set aside agency decisions unless there are substantial procedural or substantive reasons. Thus the Court preserves judicial authority to review in appropriate cases agency decisions in light of NEPA's substantive goals.

The substantive requirements of NEPA and the extent to which courts can require agencies to consider them are discussed in a significant new treatise, *Environmental Law*,[11] by Professor William H. Rodgers of Georgetown Law School. Professor Rodgers points out that NEPA's Section 101 contains sufficiently clear substantive standards to permit meaningful judicial review. He shows the close relationship between that section of NEPA and traditional U.S. case law. He notes that the NEPA requirement to "use all practicable means" to carry out environmental policies is consistent with traditional court decisions on the "nuisance doctrine," which measures the actions of people accused of creating nuisances against the standard of whether they have used the best technology to mitigate the nuisance.[12] Professor Rodgers also observes that NEPA's requirement for the federal government to "fulfill the responsibilities of each generation as trustee for succeeding generations" corresponds to court decisions requiring public officials to act in the public trust for the short- and long-term general welfare.[13]

Professor Rodgers also comments on whether the courts can consider how agencies have weighed environmental matters relative to other considerations. He cites the Eighth Circuit's decision in *Environmental Defense Fund* v. *Corps of Engineers* (*Gillham Dam*) [14]

as a firmly established doctrine (in legal terms, as "black letter law") on the scope of substantive review under NEPA:

> The court must . . . determine according to the standards set forth in Section 101(b) and Section 102(1) of the Act, whether "the actual balance of costs and benefits that was struck was arbitrary or clearly gave insufficient weight to environmental values." [15]

In his analysis of NEPA case law over 7 years, Professor Rodgers notes that in addition to the Eighth Circuit, at least seven other Circuit Courts of Appeal have followed this formulation of judicial review of NEPA's substantive standards.[16]

Achieving the substantive goals of Section 101 of NEPA is a central aim of the Council's proposed regulations for implementing the procedural provisions of Section 102 of NEPA.[17] The detailed procedural requirements that they set forth are intended to ensure that the objectives stated in Section 101 are met.[18]

Two cases involving state "little NEPAs," patterned after the federal NEPA, demonstrate how the courts have been willing to uphold environmentally protective decisions by agencies using the statute's substantive goals or provisions as authority.

In *Arcata Redwood Company* v. *State Board of Forestry*,[19] a California Superior Court upheld the authority of the State Board

of Forestry to disapprove logging companies' timber harvesting plans on the grounds that future congressional action to expand Redwood National Park would be foreclosed if the plans were executed. The Court ruled that the California Forest Practices Act alone does not authorize disapproval of the timber harvesting plans because that law was intended only to regulate the manner of timber harvesting, not whether to allow timber cutting at all. The Court noted, however, that the California Environmental Quality Act [20] required the Board of Forestry to prepare a "functional equivalent" of an environmental impact report and to consider mitigation measures and feasible alternatives to the proposed timber harvesting plans. The State Board of Forestry determined that denial of the plans would allow action by Congress on Redwood National Park, which was a feasible alternative that would eliminate adverse environmental consequences of the proposed logging. The Court accepted the agency's findings and held that the Board of Forestry was both authorized and required by CEQA to disapprove the timber harvesting plans.

Similarly, a decision by the Washington State Supreme Court upheld an agency decision based upon the substantive provisions of Washington's "little NEPA" statute.[21] The *Polygon* case was brought after Seattle's superintendent of buildings, using the State Environmental Policy Act (SEPA) as authority, denied a permit to build a 13-story condominium in an area zoned "multiple residence high density." The denial was based solely on the adverse environmental impacts anticipated from the building. The EIS for the project stated that the building was excessively bulky and out of scale and would obstruct views, increase traffic noise, and produce a shadow effect. The EIS discussed reasonable alternative structures that would cause less environmental damage.

The Polygon Corporation argued that SEPA required compliance only with the procedural duties of preparing and circulating an EIS on the proposed project and that SEPA does not confer authority to deny permits based on its substantive mandate. The Washington Supreme Court rejected this analysis:

> We hold that SEPA confers on the City, acting through its superintendent of buildings, the discretion to deny a building permit application on the basis of adverse environmental impacts disclosed by an EIS.[22]

The Court reasoned that SEPA is designed to ensure that "environmental amenities and values will be given appropriate consideration in decisionmaking" and that SEPA adds discretionary authority to a city's existing powers. The *Polygon* court's view that SEPA gives authority to make a final decision entirely upon environmental factors lends support to the analysis by Professor Rodgers that federal agencies should apply the substantive goals of NEPA in the decisionmaking process.[23] Because many state "little NEPA" cases rely on federal NEPA law, federal reliance on a significant state case such as *Polygon* would appear equally appropriate.[24]

Several important NEPA opinions in the past year dealt with the development of energy resources. The D.C. Circuit Court of Appeals concluded in one important case that the Department of the Interior's EIS on offshore oil and gas leasing in the Gulf of Alaska was deficient especially for failure to consider the alternative of delay in the leasing until an evaluation of drilling risks in the Gulf of Alaska had been completed.[25] The Court gave great deference to findings by the Council on Environmental Quality and the Environmental Protection Agency, pursuant to Section 309 of the Clean Air Act, that the proposed sale was environmentally unsatisfactory. It required Interior to articulate clearly the reasons for going forward with the sale and to write specific operating orders to ensure environmentally sound oil and gas drilling in the area.

In another case, the Second Circuit Court of Appeals opened the way for the first oil and gas development in the Atlantic outer continental shelf when it reversed the District Court's decision in *County of Suffolk* v. *Department of Interior*.[26] The District Court held that the EIS for the sale of oil and gas lease tracts in the Baltimore Canyon region did not adequately consider the effect of state and local land use controls on pipeline routes, the specific impacts of pipeline routes and landings, and the impacts of possible alternative systems of transporting oil and gas. While holding that the discussion of specific pipeline routes and onshore impacts was too speculative to address at the lease stage, the Court of Appeals emphasized that a development plan EIS would be prepared at a later stage to discuss such impacts. The Supreme Court has since denied Suffolk County's petition for certiorari. Exploratory drilling in the Baltimore Canyon began in March 1978.

In a third OCS leasing case, the U.S. District Court for Massachusetts held that the sale of oil and gas leases in the Georges Bank area off the Massachusetts coast should be delayed primarily because of violations of the OCS Lands Act but also because of inadequacies in the EIS.[27]

In addition to these OCS cases, the U.S. District Court for the District of Columbia held in *Natural Resources Defense Council* v. *Hughes*[28] that Interior's national coal program EIS was legally inadequate. In the first major direct application of *Kleppe* v. *Sierra Club*,[29] that Court held that the EIS failed to evaluate the need for extensive new leasing of federal coal reserves. The Court enjoined new coal leasing except where required to maintain existing mining operations. A subsequent modification of that opinion negotiated by Interior and the Natural Resources Defense Council allowed new leases to be issued for specified limited circumstances.

In *Sierra Club* v. *Andrus*, in which the U.S. Court of Appeals for the District of Columbia addressed NEPA's application to the federal budget process, the Court ruled that the EIS requirement does not apply to annual budget requests for the operation of the Department of Interior's National Wildlife Refuge System. The

Court held that NEPA does not require an EIS on annual budget requests for the operation and maintenance of every program with significant environmental consequences, but it does require an EIS where the request for budget approval ushers in a considered programmatic course of action following a programmatic review.[30] In another "budget" case, the U.S. District Court in Hawaii ruled that an EIS must be prepared by the Navy Department on its budget request for an aerial and surface gunnery target range.[31]

The courts also addressed NEPA's role in the legislative process. In two related cases, the U.S. District Court for the District of Columbia held that no EIS was required for testimony by the Secretary of Interior at congressional committee hearings on the proposed strip mining bill [32] and the Alaska National Park and Wilderness bill.[33] Both opinions centered upon the lack of any legal injury to the plaintiffs by the transmittal of testimony from the executive to the legislative branches of government. In contrast, the U.S. District Court and the Court of Appeals for the District of Columbia, in separate decisions, reaffirmed NEPA's application to specific project proposals for authorizing legislation which were formulated by federal agencies.[34]

Two courts reached different conclusions on whether NEPA applies to agency inaction which has environmental consequences.[35] The D.C. District Court differed with the District Court in Alaska in holding that Interior's failure to prevent wolf killing on federal lands in Alaska had environmental consequences on the fragile forest ecosystem.

NEPA LITIGATION

Federal actions challenged in the courts under NEPA still represent a small fraction of the many thousands of federal actions assessed for environmental impacts. As of December 31, 1977, 938 NEPA cases had been filed against the federal agencies surveyed.* Since NEPA's enactment 8 years ago, more than 10,000 EISs have been filed, and many times that number of environmental assessments have been made each year.

The volume of NEPA litigation reached a peak in 1974, with 189 cases filed, and has declined each year thereafter. There were 152 cases filed in 1975 and 119 in 1976. The agencies which have been surveyed for 1977 report 108 new cases.

The Department of Transportation, with 211 cases (22 percent of the total), continues to be the agency most frequently involved in NEPA litigation. The Federal Highway Administration accounts for 128 of these lawsuits. The Department of Defense has been sued in 175 NEPA cases (19 percent of the total) including 120

* As of September 1978, the Environmental Protection Agency had not completed updated litigation forms for 1977.

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cases of the Army Corps of Engineers, the Department of the Interior in 163 cases (18 percent), the Department of Housing and Urban Development in 134 cases (14 percent), and the Department of Agriculture in 93 cases (10 percent), 57 of which involved the Forest Service.

The types of federal actions or projects over which NEPA litigation has most frequently arisen are road and highway construction, with 155 cases (17 percent of the total), urban renewal projects, with 69 cases (7 percent), dam construction projects, with 49 cases (5 percent), and nuclear power projects, with 42 cases (4 percent). This ranking has not changed since last year's survey.

Citizen and environmental groups have been among the plaintiffs in 626 NEPA cases (67 percent of the total), individuals have been plaintiffs in 491 cases (52 percent), business and industry in 145 cases (15 percent), local governments in 115 cases (12 percent), and state governments in 73 cases (8 percent).* The distribution of plaintiff types has not changed significantly since last year's survey.

The most common complaint in the NEPA cases, comprising 51 percent of all allegations, is that agencies should have prepared an EIS but failed to do so. The second most common allegation (31 percent of the total) is that an EIS is inadequate. Such claims often allege failure to examine fully either the environmental impacts of an action or available alternatives.

As of December 31, 1977, 584 (62 percent) of the 938 NEPA cases filed had been completed. Nearly one-half of them (296 cases) were decided on the legal merits, with 221 decided in favor of the agencies. Of the 75 cases resolved in the plaintiffs' favor, in 56 the preparation of an EIS was ordered, and in 15 the EIS which the agency had filed was found inadequate. Of the remaining completed cases, 170 were dismissed. In 14 of them the agency decided to prepare or revise an EIS, consent decrees were entered in another 14 cases, and in 72 cases the parties reached a settlement. In 39 of the settled cases the agency agreed to file an EIS (22 cases), to revise the EIS already filed (4 cases), to modify the project (12 cases), or to halt the project (2 cases).†

In 202 (35 percent) of the 938 cases, courts issued NEPA-related injunctions which delayed the federal action or project at issue; in 92 of these cases a delay of longer than 1 year was reported. Table 9–1 gives the breakdown of these cases according to the duration of the delay.

In 59 cases, a NEPA-related injunction is presently in effect. The Department of Transportation has had the most actions delayed—50—as well as the most projects delayed for more than 1 year—27.

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* Percentages total more than 100 because often cases are brought by more than one type of plaintiff.

† These figures underestimate the totals because of incomplete agency reporting.

Table 9-1

Delays in Federal Actions Resulting from Injunctions Issued under NEPA

Reason	Number of actions
Delay because of NEPA-related injunction	
Up to 3 months	37
3 to 6 months	21
6 to 12 months	23
Over 12 months	92
Length not indicated	29
Total	202
Permanently halted by NEPA-related injunction	0
Delayed by non-NEPA-related injunction	27
No injunction issued	709
Total cases	938

The Corps of Engineers has had 47 actions delayed and has experienced delays of more than 1 year in 19.

Although no federal actions have been stopped by permanent injunctions issued under NEPA, several have been discontinued after the NEPA litigation began. Table 9–2 gives the reported bases for such decisions. Of the 60 actions which have been discontinued, 23 were stopped after a NEPA-related temporary injunction had been issued in the last court.

Table 9-2

Federal Actions Halted after Initiation of NEPA Litigation

Reason	Number of actions
Local-state decision to halt an action involving federal funds	16
Federal decision to halt an action	15
Part of a settlement agreement	6
Withdrawal of applicant	4
Injunction under another law	4
Other	15
Total	60

Table 9-3

NEPA-Related Cases[1] Completed, December 31, 1977

Agency	Cases	Lack of EIS challenged	EIS challenged as inadequate	Dismissed by trial court	Dismissed where lack of EIS challenged	Dismissed where EIS challenged as inadequate	Injunctions where lack of EIS challenged	Injunctions where EIS challenged as inadequate	Total permanent injunctions
USDA	56	39 (70)	22 (39)	19 (34)	13 (23)	6 (11)	8 (14)	5 (9)	0 (0)
USDA	4	4 (100)	0 (0)	1 (25)	1 (25)	0 (0)	1 (25)	0 (0)	0 (0)
APHI	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FMHA	1	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)
FS	41	28 (68)	16 (39)	15 (37)	10 (24)	5 (12)	5 (12)	3 (7)	0 (0)
REA	4	2 (50)	2 (50)	1 (25)	0 (0)	1 (25)	1 (25)	0 (0)	0 (0)
SCS	5	3 (60)	4 (80)	1 (20)	1 (20)	0 (0)	1 (20)	2 (40)	0 (0)
CAB	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DOC	9	6 (67)	4 (44)	3 (33)	1 (11)	1 (11)	0 (0)	0 (0)	0 (0)
DOC	3	2 (67)	2 (67)	1 (33)	0 (0)	1 (33)	0 (0)	0 (0)	0 (0)
EDA	4	3 (75)	1 (25)	2 (50)	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)
MA	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NOAA	1	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CPSC	2	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	1 (50)	0 (0)	0 (0)
CEQ	3	2 (67)	1 (33)	0 (0)	0 (0)	0 (0)	1 (33)	0 (0)	0 (0)
DOD	107	56 (52)	61 (57)	28 (26)	19 (18)	14 (13)	11 (10)	20 (19)	0 (0)
DOD	7	6 (85)	1 (14)	3 (43)	4 (57)	1 (14)	0 (0)	0 (0)	0 (0)
USAF	2	0 (0)	2 (100)	1 (50)	0 (0)	1 (50)	0 (0)	1 (50)	0 (0)
USA	8	4 (50)	5 (63)	1 (13)	0 (0)	1 (13)	0 (0)	0 (0)	0 (0)
COE	72	33 (46)	46 (64)	17 (24)	10 (14)	8 (11)	10 (14)	16 (22)	0 (0)
USN	18	13 (72)	7 (39)	6 (33)	5 (28)	3 (17)	1 (6)	3 (17)	0 (0)
DRBC	2	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DOE	26	20 (77)	9 (35)	3 (12)	1 (4)	2 (8)	0 (0)	1 (4)	0 (0)
BPA	1	0 (0)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)
ERDA	5	5 (100)	2 (40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FEA	5	4 (80)	1 (20)	1 (20)	0 (0)	1 (20)	0 (0)	0 (0)	0 (0)

FERC[a]	14	10 (71)	5 (38)	1 (7)	1 (7)	0 (0)	0 (0)	1 (7)	0 (0)
SWPA	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
EPA[a]	40	25 (63)	17 (43)	12 (30)	7 (18)	3 (8)	6 (15)	4 (10)	0 (0)
FCC	3	1 (33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FDIC	1	0 (0)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)
FRS	1	0 (0)	1 (100)	1 (100)	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)
FTC	3	3 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
GSA	17	10 (59)	9 (53)	6 (35)	3 (18)	3 (18)	1 (6)	3 (18)	0 (0)
HEW	17	13 (76)	3 (19)	8 (47)	5 (29)	2 (13)	1 (6)	0 (0)	0 (0)
HEW	14	11 (79)	3 (21)	6 (43)	3 (21)	2 (14)	1 (7)	0 (0)	0 (0)
FDA	2	1 (50)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)
PHS	1	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)
HUD	98	73 (77)	17 (17)	37 (38)	25 (26)	9 (9)	13 (13)	2 (2)	0 (0)
HUD	96	71 (74)	16 (17)	36 (38)	24 (25)	9 (9)	12 (13)	2 (2)	0 (0)
FDAA	1	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)
IHS	1	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)
DOI	83	45 (54)	35 (42)	14 (17)	9 (11)	8 (10)	7 (8)	6 (7)	0 (0)
DOI	28	16 (57)	11 (39)	7 (25)	4 (14)	3 (11)	4 (14)	2 (7)	0 (0)
BIA	4	2 (50)	2 (50)	1 (25)	1 (25)	0 (0)	0 (0)	0 (0)	0 (0)
BLM	16	10 (63)	9 (56)	5 (31)	4 (25)	4 (25)	1 (6)	0 (0)	0 (0)
BOR	4	4 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
BuRec	11	2 (18)	6 (55)	1 (9)	0 (0)	1 (9)	0 (0)	3 (27)	0 (0)
FWS	7	4 (57)	3 (43)	0 (0)	0 (0)	0 (0)	1 (14)	0 (0)	0 (0)
USGS	1	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NPS	12	7 (58)	3 (25)	0 (0)	0 (0)	0 (0)	1 (8)	1 (8)	0 (0)
ICC	12	9 (75)	4 (33)	2 (17)	2 (17)	0 (0)	1 (8)	2 (17)	0 (0)
DJUS	16	13 (81)	6 (38)	5 (31)	5 (31)	1 (6)	2 (13)	2 (13)	0 (0)
DJUS	8	5 (63)	4 (50)	1 (13)	1 (13)	0 (0)	0 (0)	1 (13)	0 (0)
BP	2	2 (100)	1 (50)	0 (0)	0 (0)	0 (0)	1 (50)	1 (50)	0 (0)
INS	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
LEAA	5	5 (100)	4 (50)	1 (13)	1 (13)	0 (0)	0 (0)	0 (0)	0 (0)
DLAB	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NASA	3	1 (33)	2 (67)	0 (0)	0 (0)	0 (0)	0 (0)	2 (67)	0 (0)
NCPC	9	7 (78)	2 (22)	2 (22)	1 (11)	1 (11)	1 (11)	1 (11)	0 (0)
NRC	25	6 (24)	14 (56)	8 (32)	1 (4)	4 (16)	1 (4)	1 (4)	0 (0)

Table 9-3 (continued)

NEPA-Related Cases[1] Completed, December 31, 1977

Agency	Cases	Lack of EIS challenged	EIS challenged as inadequate	Dismissed by trial court	Dismissed where lack of EIS challenged	Dismissed where EIS challenged as inadequate	Injunctions where lack of EIS challenged	Injunctions where EIS challenged as inadequate	Total permanent injunctions
OMB	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)	0 (0)
PRES	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)	0 (0)
USPS	3	2 (67)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SEC	4	0 (0)	0 (0)	2 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SBA	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
SSA	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
STAT	2	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)
TVA	13	12 (92)	5 (38)	2 (15)	2 (15)	1 (8)	0 (0)	1 (8)	0 (0)
DOT	137	88 (64)	61 (45)	40 (29)	25 (18)	15 (11)	17 (12)	13 (9)	0 (0)
DOT	17	11 (65)	9 (53)	4 (24)	2 (12)	2 (12)	4 (24)	4 (24)	0 (0)
USCG	7	6 (86)	1 (14)	3 (43)	2 (29)	1 (14)	0 (0)	0 (0)	0 (0)
FAA	18	13 (72)	9 (50)	2 (11)	2 (11)	0 (0)	1 (6)	1 (6)	0 (0)
FHWA	95	58 (61)	42 (44)	31 (33)	19 (20)	12 (13)	12 (13)	8 (8)	0 (0)
TREAS	14	13 (93)	1 (7)	2 (14)	2 (14)	0 (0)	2 (14)	0 (0)	0 (0)
TREAS	10	9 (90)	1 (10)	1 (10)	1 (10)	0 (0)	2 (20)	0 (0)	0 (0)
CURR	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CS	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
ORS	2	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)
WRC	2	1 (50)	1 (50)	2 (100)	1 (50)	1 (50)	0 (0)	1 (50)	0 (0)

[1] There were 584 cases; the cases column totals are higher because often more than one agency was named as a defendant. A number in parentheses is the percentage of the total number of cases in which the corresponding agency was sued.

[2] Includes cases brought against the FPC.

[3] 1976 figures.

Table 9-4

NEPA-Related Cases[1] Pending, December 31, 1977

Agency	Cases	Lack of EIS challenged	EIS challenged as inadequate	Dismissed by trial court	Dismissed where lack of EIS challenged	Dismissed where EIS challenged as inadequate	Injunctions where lack of EIS challenged	Injunctions where EIS challenged as inadequate
USDA	33	21 (64)	11 (33)	0 (0)	0 (0)	0 (0)	6 (18)	4 (12)
USDA	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
APHI	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FMHA	5	4 (80)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FS	16	11 (69)	5 (31)	0 (0)	0 (0)	0 (0)	4 (25)	1 (6)
REA	6	2 (33)	3 (50)	0 (0)	0 (0)	0 (0)	2 (33)	0 (0)
SCS	7	5 (71)	1 (14)	0 (0)	0 (0)	0 (0)	2 (29)	1 (14)
CAB	4	3 (75)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DOC	12	5 (42)	6 (50)	0 (0)	0 (0)	0 (0)	0 (0)	3 (25)
EDA	5	4 (80)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NOAA	5	0 (0)	5 (100)	0 (0)	0 (0)	0 (0)	0 (0)	2 (40)
CPSC	1	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)
CEQ	2	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DOD	68	33 (49)	36 (53)	7 (10)	6 (9)	0 (0)	9 (13)	15 (22)
DOD	3	2 (66)	0 (0)	1 (33)	1 (33)	0 (0)	0 (0)	0 (0)
USAF	8	5 (63)	3 (38)	0 (0)	0 (0)	0 (0)	2 (25)	1 (13)
USA	8	6 (75)	4 (50)	2 (25)	2 (25)	0 (0)	1 (13)	0 (0)
COE	48	20 (42)	28 (58)	4 (8)	3 (6)	0 (0)	6 (13)	14 (29)
USN	1	0 (0)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DOE	21	14 (67)	0 (0)	1 (5)	1 (5)	0 (0)	0 (0)	0 (0)
DOE	2	2(100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
BPA	5	3 (60)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
ERDA	4	3 (75)	0 (0)	1 (25)	1 (25)	0 (0)	0 (0)	0 (0)

Table 9-4 (continued)

NEPA-Related Cases[1] Pending, December 31, 1977

Agency	Cases	Lack of EIS challenged	EIS challenged as inadequate	Dismissed by trial court	Dismissed where lack of EIS challenged	Dismissed where EIS challenged as inadequate	Injunctions where lack of EIS challenged	Injunctions where EIS challenged as inadequate
FEA	5	4 (80)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
FERC[2]	5	2 (40)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
EPA[3]	19	8 (42)	8 (42)	0 (0)	0 (0)	0 (0)	1 (5)	1 (5)
EXIM	1	1 (100)	0 (0)	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)
FCC	2	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)
GSA	6	4 (67)	2 (33)	1 (17)	1 (17)	0 (0)	1 (17)	2 (33)
HEW	12	10 (83)	3 (25)	2 (17)	2 (17)	0 (0)	1 (17)	0 (0)
HEW	9	7 (78)	2 (22)	1 (11)	1 (11)	0 (0)	1 (11)	0 (0)
FDA	2	2 (100)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)
NIH	1	1 (100)	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
HUD	36	27 (75)	4 (11)	2 (6)	1 (3)	0 (0)	8 (22)	1 (3)
HUD	34	25 (74)	4 (12)	2 (6)	1 (3)	0 (0)	7 (21)	1 (3)
ILSR	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)
DOI	79	51 (65)	22 (28)	3 (4)	2 (3)	2 (3)	5 (6)	8 (10)
DOI	23	16 (70)	3 (13)	0 (0)	0 (0)	0 (0)	0 (0)	1 (4)
BIA	8	7 (88)	1 (13)	0 (0)	0 (0)	0 (0)	0 (0)	1 (13)
BLM	15	8 (53)	6 (40)	1 (7)	1 (7)	1 (7)	0 (0)	2 (13)
BuRec	17	6 (35)	10 (59)	1 (6)	0 (0)	1 (6)	1 (6)	3 (18)
FWS	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
USGS	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NPS	13	11 (85)	2 (15)	1 (8)	1 (8)	0 (0)	4 (31)	1 (8)
ICC	5	3 (60)	3 (60)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
DJUS	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
NCPC	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (100)	0 (0)

NRC	24	5 (21)	12 (50)	1 (4)	0 (0)	1 (4)	0 (0)	3 (13)
OMB	3	2 (67)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
PRES	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
USPS	11	0 (0)	1 (9)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9)
SEC	2	1 (50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
STAT	2	1 (50)	0 (0)	1 (50)	1 (50)	0 (0)	0 (0)	0 (0)
TVA	2	2 (100)	0 (0)	0 (0)	0 (0)	0 (0)	1 (50)	0 (0)
DOT	74	33 (45)	39 (53)	5 (7)	2 (3)	5 (7)	10 (14)	7 (9)
DOT	14	9 (64)	4 (29)	1 (7)	0 (0)	1 (7)	1 (7)	1 (7)
USCG	8	3 (38)	5 (62)	0 (0)	0 (0)	0 (0)	1 (13)	0 (0)
FAA	16	5 (31)	8 (50)	1 (6)	1 (6)	0 (0)	0 (0)	0 (0)
FHWA	33	16 (48)	20 (61)	3 (9)	1 (3)	2 (6)	8 (24)	6 (18)
UMTA	3	0 (0)	2 (66)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
TREAS	3	2 (67)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
CS	1	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
ORS	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
WRC	1	1 (100)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

[1] There were 354 cases; the cases column totals are higher because often more than one agency was named as a defendant. A number in parentheses is the percentage of the total number of cases in which the corresponding agency was sued.

[2] Includes cases brought against the FPC.

[3] 1976 figures.

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6. *Vermont Yankee Nuclear Power Corp* v. *NRDC,* 98 S. Ct. 1197, 46 U.S.L.W. 4301, 11 E.R.C. 1439 (1978).
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10. 46 U.S.L.W. at 4311, 11 E.R.C. at 1454.
11. W.H. Rodgers, Jr., *Environmental Law* § 7.5 (St. Paul: West Publishing Co., 1977).
12. *Id.* at n. 26.
13. *Id.* at n. 28.
14. 470 F.2d 289 (8th Cir. 1972).
15. W.H. Rodgers, *supra* note 11, at § 7.5 n. 40, quoting *Environmental Defense Fund* v. *Corps of Engineers* (*Gillham Dam*), 470 F.2d 289, 300 (8th Cir. 1972), quoting *Calvert Cliffs' Coord. Comm.* v. *Atomic Energy Commission,* 449 F.2d 1109, 1115 (D.C. Cir. 1971).
16. *Silva* v. *Lynn,* 482 F.2d 1282 (1st Cir. 1973); *Conservation Society of Southern Vermont* v. *Secretary of Transportation* (I), 362 F. Supp. 627 (D.C. Vt. 1973), *aff'd on other grounds,* 508 F.2d 927 (2d Cir. 1974), *vacated* 423 U.S. 809 (1975), *rev'd per curiam on other grounds,* 531 F.2d 637 (1976); *Conservation Council of North Carolina* v. *Froehlke,* 473 F.2d 664 (4th Cir. 1973); *Environmental Defense Fund* v. *Corps of Engineers* (Tennessee-Tombigbee), 492 F.2d 1123 (5th Cir. 1974); *Environmental Defense Fund* v. *Tennessee Valley Authority,* 371 F. Supp. 1004 (E.D. Tenn. 1973), *aff'd per curiam* 492 F.2d 466 (6th Cir. 1974); *Sierra Club* v. *Froehlke* (Kickapoo River), 486 F.2d 946 (7th Cir. 1973); *Calvert Cliffs' Coord. Comm.* v. *Atomic Energy Comm'n,* 449 F.2d 1109 (D.C. Cir. 1971). In addition, the Ninth Circuit Court of Appeals (which initially rejected substantive review in *Lathan* v. *Brinegar* (II), 506 F.2d 677 (9th Cir. 1974)) has since held that a court may review the substance of an agency's decision to determine if "the choice was arbitrary or capricious given the known environmental consequences"; see *Warm Springs Dam Task Force* v. *Gribble* (II), 565 F.2d 549 (9th Cir. 1977).
17. 43 Fed. Reg. 25230 (1978), to be codified in 40 C.F.R. Parts 1500–1508.
18. *Id.* at 25232.
19. 7 E.L.R. 20755 (Humboldt County Superior Court, No. 61910, September 8, 1977).
20. California Public Resources Code §§ 21100, 21080.5.
21. *Polygon Corporation* v. *City of Seattle,* 11 E.R.C. 1689 (Sup. Ct. Wash. 1978).
22. 11 E.R.C. at 1691.
23. Some federal courts have held that NEPA provides agencies authority, separate from their primary statutory authority, to make decisions based entirely upon environmental factors. For example, an early NEPA case, *Zabel* v. *Tabb,* 430 F.2d 199 (5th Cir. 1970), *cert. den.,* 401 U.S. 910 (1971), held that NEPA and the Fish and Wildlife Coordination Act authorized the Army Corps of Engineers to condition

or deny a dredge and fill permit on environmental grounds alone, although the Corps' own primary authority concerned navigation. A similar line of reasoning was adopted by the Ninth Circuit in a 1973 OCS leasing case. See *Gulf Oil* v. *Morton,* 493 F.2d 141 (9th Cir. 1973).

24. Federal and state courts look to judicial interpretation of NEPA to help construe state acts patterned on NEPA. *City of Davis* v. *Coleman,* 521 F.2d 661, 672 (9th Cir. 1975); *Friends of Mammoth* v. *Mono County,* 8 Cal. 3d 247, 260–61, 502 P.2d 1049, 1057–1058, 104 Cal. Rptr. 761, 769–70 (1972); *Eastlake Community Council* v. *Roanoke Assoc., Inc.,* 513 P.2d 36, 44–45 (Wash. Sup. Ct. 1973); *Wisconsin's Environmental Decade* v. *Public Service Comm'n,* 230 N.W.2d 243, 248 (Wis. Sup. Ct. 1975).
25. *Alaska* v. *Andrus,* 11 E.R.C. 1321 (D.C. Cir. 1978).
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28. 10 E.R.C. 1713 (D.D.C. 1977).
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31. *Aluli* v. *Brown,* 437 F. Supp. 602, 10 E.R.C. 1765 (D. Haw. 1977).
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33. *Chamber of Commerce* v. *Department of Interior,* 439 F. Supp. 762, 10 E.R.C. 1929 (D.D.C. 1977).
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CHAPTER 10

ECONOMICS

Environmental programs raise several basic, interrelated economic issues. The first question is how much should be spent altogether for environmental improvement. The answer depends greatly on estimated benefits—many of which cannot be measured in dollars and are therefore hard to weigh on the same scale as costs. A basic purpose of the CEQ Annual Reports is to provide the public, the Congress, and the states with the best possible information on expenditures for environmental protection and on the benefits as an aid to rational budgeting decisions.

There is no scientific method for determining the best level of expenditures. Those who look at the rate of environmental improvement may argue that spending is too low. Others, concerned about the possible economic impacts of the expenditures or believing that money could be better spent elsewhere, may argue for less. Over the past several years 2–2½ percent of the gross national product has been spent on pollution control programs.

Once the overall level of spending is determined, whether it is being spent efficiently is a concern. Within single environmental programs—the air pollution program, for example—care must be taken to concentrate efforts on the worst pollutants and the most serious problems. Similarly, priorities should be set among the environmental programs. Further, where to concentrate enforcement efforts must be determined. Because little is known about the effects of some pollutants, which investments will yield the greatest improvements is an uncertainty.

We cannot avoid these resource allocation decisions, wittingly or unwittingly, in funding environmental programs. In the past year, the Environmental Protection Agency has made some deliberate shifts to focus more attention on health–related pollution than on nonhealth problems. This focus is apparent in the agency's budgeting decisions, allocation of personnel, and public statements. Nonhealth problems will not be ignored, but EPA is setting priorities, deciding which problems to tackle first.

Although dollar estimates of the benefits and costs of control contribute to budget decisions, they are not automatic guides. Qualitative judgments are still required because it is not possible to quan-

tify all the values of either the benefits or the costs. There are too many uncertainties, particularly about benefits.

Most studies of potential benefits from pollution control programs focus on tangible damage costs. The results tend to underestimate the true benefits for two principal reasons: We still lack substantial information on the effects of pollution, and it is difficult to assign a dollar value to psychic losses. For example, we are not sure whether fine particulates in the air are a significant cause of cancer and other diseases and therefore have not estimated possible benefits of removing these pollutants. Even if this information were available, an adequate method for quantifying the misery caused by such illnesses has not been developed. Because of the difficulties, most studies ignore psychic losses and focus solely on such tangible costs as increased medical expenses. Thus, the benefit estimates—which are the obverse of the damage costs—are conservative.

It is easier to quantify most costs of pollution abatement, such as the immediate costs of installing control devices. Yet some difficulties arise in measuring the costs of economic dislocations. For example, if firms are forced to close, workers lose jobs and communities suffer. These costs, although not easily quantified, are nonetheless real and must be considered. Other environmental costs that are difficult to measure come from delays in building new productive capacity. These costs are ultimately reflected in higher market prices. Some environmental programs may possibly stand in the way of using new goods or materials. Decisions not to use these goods also exact a kind of cost, although it may be much lower than the costs of the environmental degradation that would result from producing and using the goods.

BENEFITS AND COSTS

BENEFIT ESTIMATES

Comprehensive estimates of the benefits of environmental programs are still lacking, and little new work has been undertaken. However, a recent American Lung Association evaluation of existing studies on the health costs of air pollution suggests that they have been underestimated and that they could currently amount to as much as $10 billion per year in the United States.[1]

This review concludes that many studies "suffer from inadequate data and other problems that undercut the authoritativeness of their conclusions." [2] The review observes that few of the studies considered all types of pollutants, that they tended to include only the more obvious health effects such as respiratory and heart diseases, that they did not include such nonmonetary costs as those associated with pain and bereavement, and that the dollar figures assigned to excess disease and early death are low compared with awards in court suits concerning similar injuries to health. There are indications that some of the cost estimates may be high, but on the whole

the tendency has been to underestimate costs. When all the weaknesses are considered, "a comprehensive estimate for the [current] health costs of air pollution in the U.S. could reasonably range over $10 billion per year." [3]

A study undertaken for CEQ estimated that, in a particular subset of air pollution damages, we are already experiencing benefits of approximately $5 billion per year, an amount that should double by 1985.[4]

Without the pollution abatement program, these damage costs would have increased to $8 billion in 1977 and $12 billion in 1985. With the program they were estimated at $3 billion in 1977 (down from $5 billion in 1970) and at $2 billion by 1985. Pollution control is now creating benefits of $5 billion, and benefits are projected at $10 billion per year in 1985 (estimates are in 1977 dollars). The estimates are based upon studies of past damage costs adjusted to reflect current prices, current actual and potential pollution levels, and the current population at risk. The analysis covers only a part of the total estimated damage costs for air pollution. For methodological reasons, a majority of the damage cost categories had to be omitted. (Effects on property values and on wildlife and the natural environment, including the biosphere, were not considered; for example, the greenhouse effects of carbon dioxide buildup and ozone depletion in the stratosphere were omitted.)

The estimates assume that damages are directly proportional to the amount of pollutants discharged; they are based on estimates of what pollutant discharges would have been after 1970 without the pollution abatement program, compared to projections with the program.

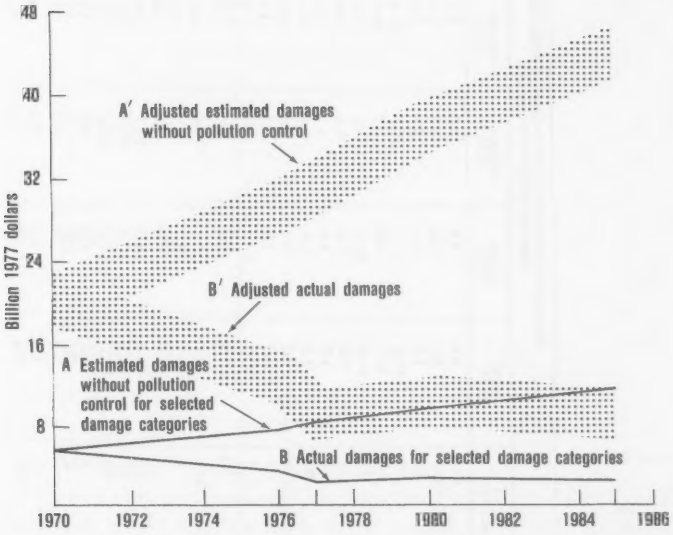
These two projections are shown as lines A and B in Figure 10–1. The difference between them is the estimated benefits from air pollution control programs for the limited number of damage categories considered. If the relationship between the potential damages (Line A) and actual damages (Line B) is the same for all categories of damage costs as it is for those that were analyzed, the total benefits of the pollution control programs would be represented by the distance between curves A′ and B′. For 1977 the total estimated benefits derived in this manner would be $22 billion.

A particularly interesting implication of the projections shown in the figure is that a large portion of the environmental improvement effort (particularly in terms of pollution control expenditures) is simply preventing deterioration beyond 1970 levels. For example, in 1985 approximately two-thirds of the dollar benefits from the pollution control program will occur because damages are not any greater than they were in 1970.

This estimate is supported by CEQ's analysis of pollution abatement costs, which suggests that more than one-half these expenditures are made just to keep the environment from becoming more degraded than it already is.[5]

Figure 10-1

Estimated Annual Air Pollution Damage Costs 1970-86



Source: Thomas E. Waddell, "Preliminary Update and Projections of Selected Categories of Damage Cost Estimates," prepared for the Council on Environmental Quality, May 1978.

It should be emphasized that these estimates are only approximate. The original damage estimates are uncertain, and the methodology used for projecting them is very unsophisticated. But the figures do provide an order of magnitude estimate of what the pollution abatement programs are doing. Unfortunately, it is impossible with the present state of knowledge to make similar estimates for water pollution damages; there the uncertainties are even greater. Of the few benefits estimates that exist, most are in terms of changes in property values and recreational benefits, benefits that are very difficult to project.[6]

ABATEMENT COST ESTIMATES

This year's Bureau of Economic Analysis survey indicates that business is expecting to invest $7.1 billion for pollution control, up 3 percent from last year (see Table 10–1).[7] Measured in constant dollars, this 3 percent increase represents an actual decline in real expenditures. An estimated $6.3 billion is being invested in municipal waste water treatment, compared to $5.4 billion in 1977. The difference is much smaller when measured in constant dollars—the increase is only 6 percent.

Table 10-1

Pollution Control Investment by Industry, 1974–78

(million dollars)

Industry	Reported expenditures 1976				Pollution control as a percentage of total plant and equipment investment				
	Total[1]	Air	Water	Solid wastes	Actual 1974	Actual 1975	Actual 1976	Actual 1977	Planned 1978
All industries	6,939	3,693	2,785	461	5.0	5.8	5.6	5.1	4.7
Manufacturing	4,282	2,032	1,993	258	8.0	9.3	8.3	7.0	6.2
Durable goods	1,668	941	636	91	7.3	8.1	6.6	5.9	5.5
Primary metals	927	607	295	26	16.6	17.2	15.7	15.7	14.4
Blast furnace, steelworks	470	282	182	5	12.1	13.5	15.1	16.7	19.5
Nonferrous metals	383	262	103	19	21.8	24.1	18.9	17.1	11.6
Electrical machinery	111	30	65	15	6.8	5.8	5.6	3.4	3.4
Machinery, except electrical	104	51	49	5	1.8	1.8	1.6	1.8	1.8
Transportation equipment	163	58	74	31	3.7	3.4	3.4	3.1	4.0
Motor vehicles	142	49	63	30	4.1	3.9	3.6	3.5	4.7
Aircraft	21	9	11	1	2.9	2.8	3.3	2.1	2.1
Stone, clay, and glass	149	107	39	4	12.9	14.3	6.1	7.3	7.3
Other durables	213	88	116	10	4.5	5.3	3.9	3.6	2.9
Nondurable goods	2,615	1,091	1,357	167	8.7	10.3	9.6	8.0	6.8
Food, including beverages	176	71	96	8	4.7	5.2	4.5	4.2	4.7
Textiles	35	11	23	1	3.3	4.6	4.4	3.8	3.5
Paper	468	188	256	23	19.3	16.8	14.7	13.8	9.6
Chemicals	701	249	414	38	8.3	10.9	11.4	10.2	9.2
Petroleum	1,167	531	546	90	10.1	11.8	10.9	8.2	7.0
Rubber	47	31	12	4	3.2	4.0	3.4	3.3	3.0
Other nondurables	21	9	9	2	1.8	2.8	1.4	1.2	1.0

Nonmanufacturing	2,657	1,661	792	204	3.0	3.2	3.5	3.5	3.6
Mining	97	38	32	27	1.8	1.9	2.2	2.2	3.1
Railroad	28	4	23	2	1.2	1.4	1.1	1.0	1.4
Air transportation	14	12	1	1	0.0	0.6	1.2	0.8	0.9
Other transportation	23	11	10	2	2.3	1.4	1.1	1.0	0.9
Public utilities	2,300	1,525	654	121	7.9	8.4	9.1	8.8	8.7
Electric	2,271	1,514	636	121	8.9	9.7	10.5	10.4	10.4
Gas and other	30	11	18	1	1.5	1.5	1.2	0.7	0.8
communication, commercial, and other	195	73	72	51	0.6	0.6	0.5	0.5	0.5

[1] Totals may not add because of rounding.

Source: *Survey of Current Business* 55(7):15 (1975), 57(6):13 (1977), and 58(6):33 (1978).

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The Council estimates that on the whole, including government and private expenditures, the nation is spending $47.6 billion for pollution control in 1978, approximately $215 per capita.[8] Of this amount, only $22.7 billion is in response to environmental legislation; the remainder would have been spent without it. Spending in response to legislation has increased 20 percent since 1977, but corrected for inflation the increase is approximately 12 percent.

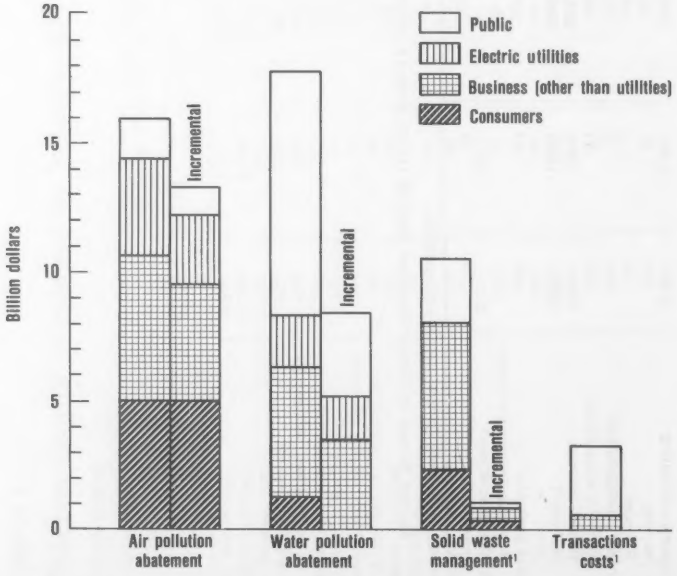
The 1978 estimate is shown in detail in Figure 10–2. Of total outlays, industry accounted for 48 percent, government for 34 percent, and consumers directly for 18 percent. Air pollution abatement received 33 percent of the funds, water 37 percent, and solid waste management 22 percent. Of incremental outlays, industry accounted for 57 percent, government for 20 percent, and consumers directly for 23 percent. Air pollution abatement received 58 percent of the funds, water 37 percent, and solid waste management 5 percent.

COSTS ASSOCIATED WITH RECENT LEGISLATION

The cost estimates for 1978 do not yet include many costs associated with environmental legislation enacted during the past 1 or

Figure 10-2

Estimated Pollution Control Expenditures 1978



[1]Electric utilities and business combined.

2 years: the hazardous waste section of the Resource Conservation and Recovery Act of 1976,[9] the Toxic Substances Control Act of 1976,[10] the 1977 amendments to the Federal Water Pollution Control Act,[11] and the 1977 Amendments to the Clean Air Act.[12] For most of this legislation EPA is still in the process of developing its final regulations, and the costs will not be felt until businesses and government begin to implement the regulations.

Hazardous Waste Regulations

The Resource Conservation and Recovery Act of 1976 requires the creation of a recordkeeping system to track wastes from the point of generation to their ultimate disposition and provides for standards for hazardous waste storage, treatment, and disposal facilities.

EPA has studied the compliance costs to all those involved in generating, transporting, storing, treating, and disposing of hazardous wastes and also the effect of these costs on product prices, plant closures, and other economic impacts for a number of selected industries. On the basis of preliminary, incomplete assessments, EPA estimates the costs of complying with the technical specifications of the new law at approximately $377 million per year, which will add less than 1 percent to prices in the most heavily affected industries. Few plant closures are expected.[13]

It is important to keep in mind the fact that the industry studies on which these estimates are based are preliminary. They were undertaken before official criteria for hazardous wastes were defined, and in an effort to be conservative, many of them defined a waste stream as hazardous if it contained *any* of the specified elements or compounds in concentrations higher than are usually found in the natural environment. Thus some costs may be overestimated. On the other hand, not all the costs of compliance have yet been estimated. Costs still to be estimated are:

- The administrative costs of recordkeeping, reporting, and permit application
- The cost to hazardous waste disposers of maintaining acceptable financial liability for claims arising out of damage to property or persons

Another limitation is that the studies did not analyze all waste streams for each industry for hazardous waste potential, but only for selected industries. Estimates of the remaining hazardous waste volumes are being prepared.

In view of these limitations, the estimates of direct costs of compliance for 17 industries must be regarded as tentative and rough.[14] The method of estimating costs was to assign each waste stream to 1 of 12 waste categories and then to estimate costs both for the existing disposal method and for an environmentally acceptable disposal method. The difference between these two costs is the incremental cost of federal hazardous waste regulations. The cost estimates are shown in Table 10–2. The total annual cost of satisfactorily

Table 10-2

Summary of Generation Rates, Unit Costs, and Total Costs of Hazardous Waste Disposal

Waste stream description	Projected annual amount of waste in 1977 (thousand metric tons)	Unit treatment and disposal costs (dollars per metric ton)		Total annual cost (thousand dollars)	Annual incremental cost of acceptable methods (thousand dollars)
		Existing methods	Environmentally acceptable methods		
Solids and sludges containing hazardous materials	7,110	5.99	33.1	235,000	193,000
Process wastes	149	26.1	55.6	8,280	4,400
Solvents and solvent sludges	139	67.9	107	14,860	5,420
Heavy ends and still bottoms	369	32.9	83.0	30,600	14,600
Petroleum industry solids and sludges (landfill)	1,218	21.2	36.9	44,960	19,100
Petroleum industry bottoms and sludge (landspreading)	321	19.0	11.1	3,570	0
Paint wastes	529	17.3	58.1	30,800	21,600
Smelting industry solids and sludges	13,800	1.36	3.99	55,100	36,400
Explosives	87	252	949	82,500	60,000
Pesticides	987	1.89	26.4	23,665	21,970
Miscellaneous	1.5	455	455	683	0
All categories	24,710.5	6.19	21.45	530,018	377,090

Source: Battelle-Columbus Laboratories, "Cost of Compliance with Hazardous Waste Management Regulations," prepared for the U.S. Environmental Protection Agency (Columbus, Ohio, 1977).

treating and disposing of hazardous wastes is estimated at $530 million or $21.45 per metric ton (wet basis). This amount includes routine treatment costs of $153 million—$6.19 per metric ton—and the additional annual incremental cost of $377 million—$15.26 per ton—as a result of federal regulations.[15]

EPA conducted studies of specific industries that are likely to experience the highest impacts.[16] In general, cost increases in these industries are lower than 1 percent of product selling prices, and only marginal plants may be forced to close. The following are significant results by sector for the industries for which the analyses have been completed:

- Organic chemicals, pesticides, and explosives—Production costs to the industry as a whole are expected to increase 0.6 percent, with producers of perchloroethylene showing a worst case cost impact of 5.0 percent. Five other chemicals are also expected to be substantially impacted, and 6 of the 57 plants producing these six chemicals are subject to possible shutdown.
- Batteries, electronics, and special machinery—The annual costs are small for all three industries, ranging from 0.02 to 0.06 percent of sales, although some large lead–acid battery plants using lime for acid neutralization and solid precipitation will incur annual disposal costs of 0.1 percent of sales.

- Inorganic chemicals—The cost impact on most of the 13 inorganic chemicals and chemical processes assessed is modest (0.4–0.6 percent of selling price), with the exception of hydrofluoric acid (1.4 percent) and chlorine (1.8 percent). One or two hydrofluoric acid plants may have to close because of hazardous waste regulations.
- Pharmaceuticals—The economic impacts on this industry will be small, with the cost of compliance being less than 0.02 percent of sales. The compliance cost for the formulation–packaging sector is expected to be approximately 0.06 percent of sales.
- Leather tanning—Three of the six segments studied will have hazardous waste management costs larger than 0.5 percent of revenues; the largest is 3.4 percent. But price increases are very unlikely because of international competition. Some small cattlehide–splits plants may close.
- Paints and allied products—No heavily impacted segments have been found, but incremental costs as a percentage of cash flow for very small plants could reach 5.9 percent in trade sales paints and 7.0 percent in industrial finishes, causing closure of some small plants.

Toxic Substances Legislation

The Toxic Substances Control Act (TSCA) gives EPA the authority to require selective testing of new and existing chemical compounds; receive premanufacturing notices 90 days prior to the manufacture of any new chemical or significant new use of an existing chemical; control the manufacturing, processing, distribution in commerce, use, and disposal of any chemical substance; and require reporting of certain information on chemicals. There are no estimates of the total costs of the Toxic Substances Control Act as it was finally passed by the Congress in 1976. They will depend on the manner in which the Act is implemented, and EPA considers it too early to estimate such costs accurately.

Before the law was passed, a number of estimates of the costs to the chemicals industry of various versions of TSCA were circulated —EPA estimated $80–140 million,[17] the Manufacturing Chemists Association estimated $360 million to $1.3 billion,[18] and Dow Chemical estimated $2 billion.[19] The General Accounting Office, at the request of the Senate Committee on Commerce, reviewed the EPA, MCA, and Dow studies and estimated the annual cost to the chemicals industry at about $100–200 million.[20] Costs to other segments of industry have not been estimated and are highly dependent on the specific chemicals regulated and the way in which they are regulated.

Some part of TSCA costs, those due to regulations promulgated to date, have been estimated. EPA's first regulation under TSCA requires chemical companies to report the identity, volumes, and location of production of each chemical that they manufacture; the information will be used to compile an inventory of chemical sub-

stances in commerce in the United States. The cost to industry of this first reporting regulation will be approximately $15 million.[21]

Regulations requiring the marking and disposal of polychlorinated biphenyls (PCBs) and banning the use of chlorofluorocarbons (CFCs) as aerosol propellants will have greater cost impacts. Labeling and disposal of PCBs will cost approximately $55 million per year for the first 5 years, declining to $42 million in the next year and dropping about 7 percent each year thereafter as equipment containing PCBs is removed from service. This regulation will primarily affect electric utilities and large users of electricity.[22] The fluorocarbon regulations will cost industry between $170 and $270 million per year over the next 4 years, with the major impact on marketers. However, these costs may be offset by savings to consumers. Because the substitutes for CFC propellants in aerosol products are cheaper, the regulation should result in consumer savings of between $60 and $240 million per year.[23]

COST PROJECTIONS

Each year the Council estimates costs of complying with environmental regulations over a 10-year period. As detailed in Table 10–3, this year's projection of incremental abatement costs (the additional costs resulting from federal environmental regulations beyond what would otherwise have been spent) totals $361.3 billion for 1977 through 1986; 59 percent, $213.6 billion, is for air pollution control and 35 percent, $124.7 billion, is for water pollution control. The remainder is for solid wastes, noise, toxic substances control, land reclamation, and control of radioactive materials. Total cost estimates are given in Table 10–4.[24]

The difference between the current estimate and last year's is the result of inflation (the 1978 estimate is in 1977 dollars; the 1977 estimate was in 1976 dollars), a change in the period covered (1986, a high cost year, was added, and 1976, a lower cost year, was dropped), and modification of environmental regulations since last year's estimate was prepared.

The consumer will directly pay $71.4 billion of the cumulative costs of pollution control for 1977 through 1986. This share goes for automobile pollution abatement and solid waste collection. Approximately $1.2 billion of the mobile source costs that the consumer pays is for federal and state gasoline taxes and therefore does not represent consumption of actual resources. The government will spend $69.5 billion ($68.5 billion net after subtracting taxes collected on the increased gasoline consumption—costs that are ultimately paid by the taxpayer. Electric utilities will pay $74.3 billion and other industries the remaining $146.1 billion. Most of these costs will be passed on to the consumer in the form of higher electricity and product prices. As consumers and taxpayers, people ultimately pay all the costs of cleaning up the environment.

Table 10-3

Estimated Incremental Pollution Abatement Expenditures,[1] 1977–86

(billion 1977 dollars)

	1977			1986			Cumulative (1977–86)			
	Operation and maintenance	Capital costs[2]	Total annual costs[3]	Operation and maintenance	Capital costs[2]	Total annual costs[3]	Capital investment	Operation and maintenance	Capital costs[2]	Total annual costs[3]
Air pollution										
Public	0.2	0.1	0.3	2.2	0.9	3.1	5.1	15.2	6.0	21.2
Private										
Mobile	2.5	3.0	5.5	1.4	7.7	9.1	51.2	21.3	58.3	79.6
Industrial	1.9	2.2	4.1	3.5	4.7	8.2	18.8	27.3	33.9	61.2
Utilities	1.3	1.0	2.3	5.1	3.8	8.9	20.8	29.5	22.1	51.6
Subtotal	5.9	6.3	12.2	12.2	17.1	29.3	95.9	93.5	120.3	213.6
Water pollution										
Public	1.3	0.4	1.7	5.0	2.4	7.4	26.4	31.4	13.8	45.2
Private										
Industrial	1.7	1.3	3.0	4.9	3.9	8.8	24.0	32.0	24.8	56.8
Utilities	1.0	0.6	1.6	1.8	1.1	2.9	4.2	14.2	8.5	22.7
Subtotal	4.0	2.3	6.3	11.7	7.4	19.1	54.6	77.6	47.1	124.7
Radiation										
Nuclear powerplants	<0.05	<0.05	<0.05	<0.05	0.1	0.2	0.2	0.1	0.3	0.4
Solid wastes										
Public	0.2	0.1	0.3	0.4	0.1	0.5	1.2	2.9	0.9	3.8
Private	0.3	0.2	0.5	1.1	0.5	1.6	1.8	7.7	1.7	9.4
Subtotal	0.5	0.3	0.8	1.5	0.6	2.1	3.0	10.6	2.6	13.2
Land reclamation										
Surface mining	NA	NA	NA	0.6	NA	0.6	NA	4.0	NA	4.0
Toxic substances	NA	NA	NA	0.2	NA	0.2	NA	1.2	NA	1.2
Noise	NA	NA	NA	0.4	0.5	0.9	3.0	2.0	2.2	4.2
Total	10.4	8.9	19.3	26.6	25.7	52.4	156.7	188.8	172.5	361.3

NA = Not available

[1] Incremental costs are expenditures made pursuant to federal environmental legislation beyond those that would have been made in the absence of such legislation.

[2] Interest and depreciation.

[3] Operation and maintenance plus capital costs.

In terms of real resource costs, CEQ estimates that $156.7 billion will be invested in capital equipment and $187.6 billion spent on operation and maintenance costs (after deducting taxes) over the 10 years. For most sectors O&M costs will become relatively more important over time, although mobile source abatement is expected to be a significant exception.

The incremental real resource abatement costs (investment plus O&M less taxes) are estimated to amount to approximately 2.15 percent of the gross national product in 1978.[25] This is the same as the estimate for 1977. Figure 10–3 shows the trend since 1972.

The proportion is expected to level off through 1983 as investment costs and GNP grow at similar rates; it will then decrease because after 1983 all existing plants should have made the necessary investment to comply with pollution control requirements.

Private pollution control investments (excluding mobile sources) are estimated at less than 2.1 percent of gross private domestic investment and 4.7 percent of total business investment in plant and equipment in 1978.[26] These ratios are expected to fall temporarily before rising to a second peak in the early 1980's as increased investments are made in order to comply with the 1983 deadlines established in the Water Pollution Control Act.

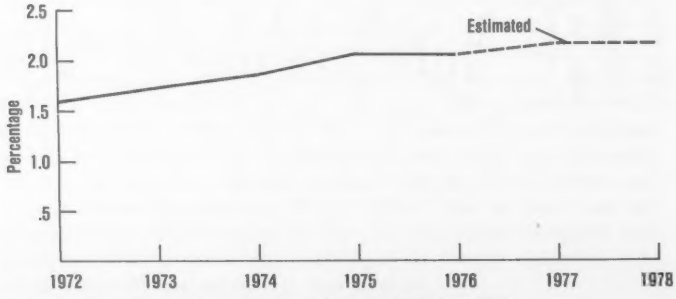
MACROECONOMIC IMPACTS

IMPACTS ON EMPLOYMENT

Unemployment and how to reduce it remain a major economic issue in 1978. Environmental programs are frequently accused of being a major cause of unemployment. Yet the expenditures stimulated by the air and water pollution control deadlines and by the

Figure 10-3

Pollution Control Expenditures as a Percentage of Gross National Product 1972-78



Source: For 1972-76, *Survey of Current Business* 58(2):12 (1978).

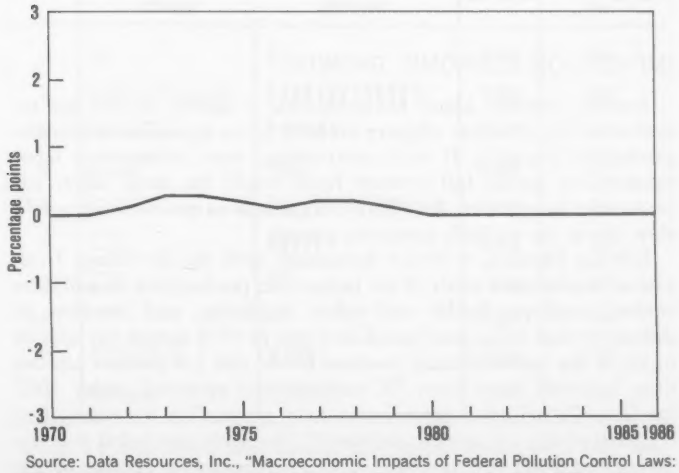
municipal grants program also produce jobs. Not only are workers needed to manufacture the pollution control equipment and construct the facilities, but over the longer term many will be needed to operate and maintain the equipment. As reported last year, a National Academy of Sciences committee estimated that 677,900 people were employed in pollution control activities in 1974.[27]

A recently completed macroeconomic analysis sponsored by CEQ and EPA analyzed the impacts of pollution control programs on unemployment as well as a number of other variables. This analysis, like earlier ones, indicates that these programs have very little net impact on the unemployment rate (Figure 10–4).

Although the overall employment impact of environmental pollution controls over the 1976–86 period is not large, some individual plants may be forced to close because of environmental pollution control requirements. These closures and the unemployment that they cause may be significant for the communities that they affect, and they are clearly of great concern to employees and owners as well as to EPA. By determining as early as possible where such dislocations are likely to occur, EPA can help to target federal assistance and take other appropriate measures (see the discussion of these efforts below). In addition, detailed knowledge of plant closure and unemployment information enables EPA to determine the specific impacts of its regulatory activities. EPA monitors threatened and actual closings with its Economic Dislocation Early

Figure 10-4

Estimated Change in Unemployment Rates with Pollution Control Expenditures



Source: Data Resources, Inc., "Macroeconomic Impacts of Federal Pollution Control Laws: 1978 Assessment" (Washington, D.C., Council on Environmental Quality, 1978), preliminary results.

Warning System. Figure 10–5 summarizes the reports received by EPA from January 1971 through December 1977 on plants which purportedly closed at least partially because of environmental regulations. In all, 118 plants affecting over 21,900 employees (0.02 percent of the labor force) were reported to be affected.[28]

The Department of Commerce has also surveyed plant closings associated with pollution control requirements. In 1977, less than one-half of 1 percent of the companies in the survey reported a plant closing. This figure amounted to 12 facilities in 1977—about one-half of the 1976 figure. Most permanent closings did not occur solely as a result of environmental regulations.[29]

Probably some net job loss occurred as a result of these plant closings because the plants which increase production to make up for those that closed are likely to be more efficient than the ones that closed. The latter are usually older, smaller facilities that are only marginally profitable even without the required environmental controls. It is their relative inefficiency that leads to decisions to close rather than modernize them. In an earlier Department of Commerce survey, age or obsolescence of a facility was cited as a contributing factor in over 60 percent of the plant closings.[30] In many instances facilities would soon have been closed anyway, and environmental regulations simply accelerated the process.

The problem of plant closings should not be understated, however. There is some geographical concentration of the plants which have closed, and many are located in older industrial towns already suffering relatively high unemployment rates.[31] The closures can seriously hurt the local economy and the people who may have difficulty finding other jobs. The government has a series of programs, discussed later in the chapter, which attempt to avoid or reduce these impacts.

IMPACTS ON ECONOMIC GROWTH

Another concern about environmental programs is that the investments required may displace investments to expand or modernize production capacity. If such substitutions were widespread, labor productivity would fall because firms would be using older, less productive equipment, and the lower growth in productivity would slow down the nation's economic growth.

Edward Denison, a Senior Economist with the Brookings Institution, conducted a study of the impacts on productivity of pollution control, employee health and safety legislation, and increases in dishonesty and crime, and concluded that in 1975 output per unit of input in the nonresidential business sector was 1.8 percent smaller than it would have been "if business had operated under 1967 conditions"; pollution control was held responsible for more than one–half of this 1.8 percent decrease.[32] The study concluded that the economic growth rate in 1975 was 0.5 percent lower because of the three factors analyzed than it would have been without them.

Figure 10-5

Plant Closings Allegedly Resulting in Part from Pollution Abatement Costs, April 1978

4 Plants 400 Employees

Region	Number of plant closings	Number of affected employees	Labor force (thousands)	Regional unemployment rate
I			5,871	8.4
II			7,830	9.2
III			13,906	7.4
IV			15,884	6.7
V			20,905	5.9
VI			10,251	5.6
VII			5,550	4.4
VIII			2,974	5.7
IX			12,242	8.5
X			3,443	8.5

Source: U.S. Department of Labor, *Bureau of Labor Statistics News*, June 12, 1978; letter from Douglas Costle, Administrator, U.S. Environmental Protection Agency, to Ray Marshall, Secretary of Labor, May 9, 1978.

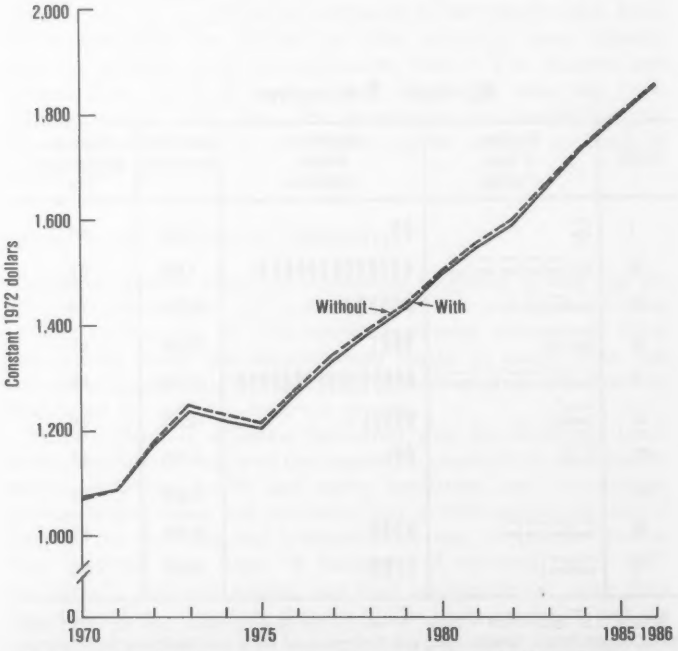
The Council and EPA also sponsored a macroeconomic analysis to determine the impacts of pollution control expenditures on economic growth.[33] The results of this analysis, shown in Figure 10–6, indicate that the impact is much less.

A major different between the two studies lies in their assumptions about how much "productive" investment would have occurred without the pollution abatement expenditures. Denison assumes that if pollution abatement took 6 percent of total plant and equipment investment in a particular year, then "productive" plant and equipment investments were approximately 6 percent lower during that year than they would have been had there been no pollution control investment.

The CEQ–EPA analysis, on the other hand, using macroeconomic models which simulate the operation of the economy, attempt to estimate how much "productive" plant and equipment investment is actually displaced by pollution control expenditures. Particularly during the recession of the early 1970's, these analyses

Figure 10-6

Estimated Gross National Product with and without Pollution Control Expenditures 1970-86



Source: Data Resources, Inc., "Macroeconomic Impacts of Federal Pollution Control Laws: 1978 Assessment" (Washington, D.C., Council on Environmental Quality, 1978), preliminary results.

indicate that the rate of displacement was much less than Denison assumes. The CEQ–EPA analyses indicate that every dollar of pollution control expenditures displaced only 33–40 cents of other plant and equipment investment. Thus the $6.5 billion of private pollution control investment displaced approximately $2.6 billion of "productive" plant and equipment investment in the CEQ analysis —not the $6.5 billion implicit in Denison's analysis.

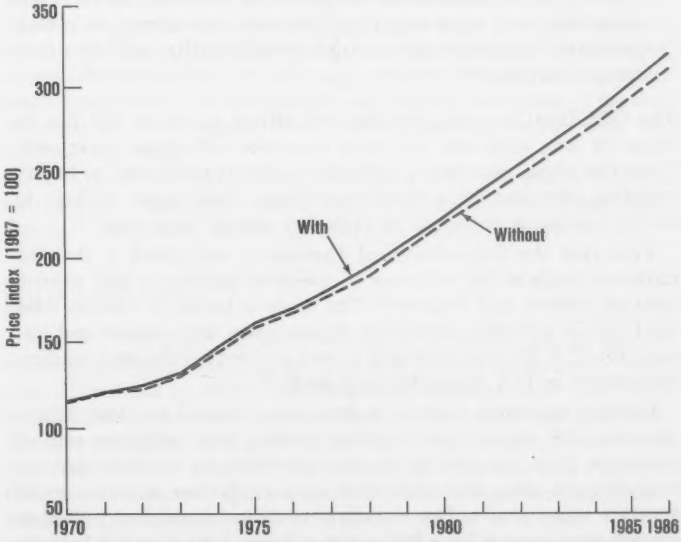
IMPACTS ON INFLATION

In addition to unemployment, inflation was an important economic concern in 1978. The CEQ–EPA analysis also showed the impact of pollution control programs on inflation. The results, indicated in Figure 10–7, show extra inflation rates of 0.0–0.4 percent per year resulting from spending for pollution control.

It should be recognized that these analyses all assume that the economy is working smoothly and that there is sufficient production capacity and capital availability to satisfy all demands for investment, raw materials, and intermediate goods. Where "structural bottlenecks" exist, reducing supplies of these items below what they

Figure 10-7

Estimated Consumer Price Index with and without Pollution Control Expenditures 1970-86



Source: Data Resources, Inc., "Macroeconomic Impacts of Federal Pollution Control Laws: 1978 Assessment" (Washington, D.C., Council on Environmental Quality, 1978), preliminary results.

would be in a smoothly functioning economy, the analyses may understate the rate of inflation and the degree of economic disruption. To the extent that environmental programs contribute to these bottlenecks (e.g., by interfering with smooth industrial capacity expansion), their adverse impacts are similarly understated.

IMPACTS ON FOREIGN TRADE

Another issue is the foreign trade situation and balance of payments. During the past year the United States has experienced record high trade deficits, and the impacts of pollution control or of any other policy are a matter of concern. Two recent studies support earlier studies that evidence of industry–specific impacts on trade and the balance of payments from pollution has not been found. On the whole, it appears that impacts on aggregate trade patterns will not be severe.

In *Economic Implications of Pollution Control,* an Organization for Economic Cooperation and Development study, several possible effects of environmental policies on the balance of payments and trade are specified:

- Impacts from the costs of pollution control will be confined to goods that are traded by relatively few industries.
- Trade in these goods will be affected in the short and medium term by the size of price increases associated with pollution control, the importance of the goods in the trade of both the importing and exporting countries, and the extent to which producers in competing countries are affected by pollution control and its costs.[34]

The OECD study concludes that the effects on trade will not be severe or long term and that most countries will adjust quite well. Countries whose exports are primarily products fabricated by highly polluting processes are a notable exception; their trade is likely to be more seriously disrupted by pollution control programs.

This year the Department of Commerce completed a detailed statistical study of the influence of pollution abatement and control costs on exports and imports.[35] The study is based on Census data for 1973–76 pollution abatement expenditures and exports and imports for 47 U.S. manufacturing sectors selected on the basis of their importance in U.S. manufacturing trade.[36]

Detailed statistical analysis of these data showed no clearcut impacts on U.S. exports and imports resulting from pollution control programs. It is not possible to conclude from the analyses that no such impacts exist, and additional data or further analyses could generate other results. But in failing to demonstrate that pollution control requirements have had any significant impact on our balance of payments, this most recent study is consistent with many that have preceded it.

MICROECONOMIC IMPACTS

The analyses reported above indicated that although the macroeconomic impacts of federal pollution control programs are not substantial, there is continuing concern over the impacts on specific industries. EPA attempts to estimate these industrial impacts in the process of establishing its regulations and has undertaken a series of intensive studies of the most seriously affected industries to assess the effects of all the environmental regulations together. Several of the studies are summarized below.

IRON AND STEEL

The proportion of the iron and steel industry's capital expenditures allocated to pollution control increased from 13.5 percent in 1976 to 19 percent for 1977.[37] An EPA study estimates that full compliance with air and water pollution regulations will require as much as $6.8 billion (1975 dollars) additional investment between 1975 and 1983.[38] (The estimate does not reflect recent regulatory revisions in water pollution control requirements.) Pollution control will account for approximately 20 percent of the industry's total capital expenditures during that period; if these costs are fully reflected in consumer prices, the increase would be on the order of 4.6 percent by 1983.

Capital availability will be a significant concern for the steel industry. Total capital requirements for modernization, capacity expansion, and pollution control will far exceed the industry's internal sources of funds, thereby straining its sources of external financing as well. But because of poor earnings and dim prospects for improved market conditions, the industry has only limited intentions at present to invest in new capacity, thus lessening the immediate need for external financing.

In 1977 several firms closed portions of their operations, but environmental regulations played only a minor role in these shutdowns.[39] Most were caused primarily by foreign competition.

PULP AND PAPER

In 1977 the paper industry allocated 14 percent of its capital expenditures to air and water pollution control equipment, down from 15 percent in 1976.[40] An EPA study estimates that from 1975 to 1983 this proportion could average as much as 27 percent, with an estimated $6.4 billion (1975 dollars) being invested over the 8 years for pollution control. Few closures are expected as a result of these added expenses; approximately 2 percent of the firms may close, affecting approximately 1 percent of the workers in industry.[41] Only marginal firms are likely to close. The pollution control expenditures may cause price increases of 5–7 percent, but no supply shortages are expected as a direct result of pollution control expenditures.

METAL FINISHING

The metal finishing industry faces a particularly difficult task in complying with pollution control requirements because the costs are high and the industry is characterized by small shops, generally having fewer than 20 employees. The electroplating process creates severe water pollution problems, and control on a small scale is very expensive for a small electroplater; there are economies of scale in treating this kind of pollution. Because very little capital investment is required to enter this industry, investment requirements for pollution control are a significant fraction of total investment—in some cases exceeding all other investment.

Many firms dispose of their wastes in municipal sewage treatment systems, and they will have to pretreat their wastes before disposing of them in these systems to remove toxic and hazardous materials. EPA estimates the total investment costs to achieve compliance with the pretreatment standards at $460.7 million (January 1977 dollars), and the annual compliance costs (including both O&M and capital charges) at $128.9 million.[42] Although the proposed guidelines probably will not have the drastic economic impacts that were previously feared, they will significantly affect a large number of independent firms whose *primary* business is metal finishing. These firms are in a worse situation than "captive" operations, which are parts of larger firms and therefore are likely to have much better access to capital. Although no good figures exist, it appears that there may be many more captive than independent shops.

As many as 20 percent of the job shops and 14 percent of the independent printed circuit board makers may close as a result of added compliance expenses.[43] For the remaining independent firms, profits are expected to rise to their original level within a few years. Among captive shops, 1 percent may be phased out, but no plants with captive operations are expected to close as a result of pollution control requirements. The estimated job shop closures could affect 21 percent of job shop workers (12,500 jobs). The circuit board closures could affect 15 percent of circuit board workers (3,135 jobs). Most of the workers displaced from closure of captive operations (322 affected workers) could be absorbed into other operations within the same firms.

Community and regional impacts resulting from these closures are not expected to be severe because metal finishing job shops are a relatively minor employer in most communities. The impacts on the overall rate of industry growth are expected to be negligible, resulting in a general movement away from very small operations. This effect reflects the economies of scale inherent in pollution abatement treatment.

STEAM ELECTRIC POWERPLANTS: THERMAL POLLUTION

The pollution control problems of electric utility companies, when

combined with considerations of national energy policy, are truly complex. The bulk of the pollution problem is air related, but water pollution problems (particularly thermal pollution) are also encountered in the generation of electricity. The usual method of abating thermal pollution is through the use of cooling towers. Steam electric power generation accounts for approximately 80 percent of all use of cooling water by U.S. industry.[44]

A 1977 study of the problem of controlling thermal pollution in the steam electric power industry indicated that additional capital expenditures of $894.4 million (1977 dollars) will be required for this purpose between 1977 and 1987.[45] This figure represents an increase of approximately 0.3 percent in capital costs. The estimates assume the use of the most cost–effective technology, but they also install thermal pollution control equipment. Because these assumptions are relatively conservative, it is likely that the estimates overstate the spending that will occur.

Seven compliance technologies were considered in the study. The most costly was technology to reduce the volume of cooling water intake, which would add 13 percent to base production costs in an average existing 900–megawatt fossil fuel plant. No other compliance technology adds more than 3 percent to the base costs, and the least costly would add only 0.04 percent at most. All the costs cited are variable and are highly sensitive to the individual conditions of each plant. For example, in the case of cooling water, the costs depend substantially on the distance from the water intake to the powerplant.

Pollution control requirements could cause average consumer electric bills to increase $0.05–3.00 per month, depending on the types of powerplants in the system and the particular compliance technology employed.

COPPER

There has been little growth in the U.S. copper industry in the past 3 or 4 years, and a recent economic study concludes that there will be little if any growth in smelting capacity through 1985 because of the lead time required for conversion to environmentally sound processes.[46] Further, growth after 1985 is not assured because of unsolved problems with fugitive emissions and because of the large capital outlays required during the 1980's to meet State Implementation Plan (SIP) limitations on sulfur dioxide emissions.

The study assessed impacts on prices, imports, and consumption relative to a baseline forecast which assumed that ambient standards would be met through use of Supplemental Control Systems (SCS) with a minimal level of permanent emissions control. The baseline capacity forecast takes into account the industry's historical investment response to prices, cash flow, return on capital, and other

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financial variables. For its most likely environmental scenario, the study assumes that

- All existing copper smelters remain open
- All smelters will meet the SIP emissions limit for sulfur dioxide by the end of 1987
- There will be no dramatic breakthroughs in sulfur dioxide technology and control costs
- Large permanent production curtailments will not be required to control low level fugitive emissions
- There will be a return to steady macroeconomic growth in the United States and other industralized countries by 1980.

Under these conditions, the study concludes:

- Capacity is 17 percent lower than in the baseline case by 1983 and 26 percent lower in 1987
- Prices are 16 percent higher by 1983 and 29 percent above baseline in 1987
- Imports are 14 percent higher by 1983 and 16 percent above baseline in 1987
- Pollution control investment for 1974–87 will total $1.8 billion, of which 30 percent has already been invested.

Much of the projected price increase in the 1983–87 period under this scenario is a result of constrained capacity, which in turn is partly a result of the assumption that emission controls will be added to outdated heavily polluting smelting technology. In fact, only one new smelter has been built in the last 20 years. In the outdated plants that are typical of the industry, it is extremely difficult to make small additions to capacity, meet environmental regulations, and make a profit. The alternative is long-term conversion of the standard smelting process. Consequently, existing smelters are unlikely to provide much growth. New facilities require long lead times and none is currently in advanced planning. Therefore, on technical grounds alone, capacity increases before 1985 are highly unlikely. Considering the current depressed state of the world copper market, the large expenditures which copper producers will have to make to meet SIP emissions requirements and the uncertain capability of new smelters to control fugitive emissions adequately, there is even less reason to expect much new smelting capacity through 1987.

In an effort to lessen the capacity constraints projected in this study, EPA is allowing limited increases in SO_x and particulate emissions at the four cleanest smelters after installation of control technology. This policy could allow capacity expansion of up to 10 percent over the current level. It will probably not affect expected price increases through 1983, but if it allows more expansion to take place, prices could probably be held to 17 percent above baseline in 1987 (compared to 29 percent if no emissions increases were allowed). The industry received special consideration by the Congress in the 1977 Amendments, which allow nonferrous smelters to

obtain waivers from the requirement that every facility install the best practical control technology for continuous SO_x emission reductions. These waivers are to be based on a plant-level financial analysis of a smelter's ability to afford pollution controls.

ECONOMIC ASSISTANCE [47]

Environmental programs are based primarily on the principle that the generator of pollution should pay the cost of abating it. Nevertheless, it is recognized that the general public benefit of rapid, substantial improvement in environmental quality may entail burdensome costs to a few firms or communities. A number of programs have been established to provide economic assistance that will help avoid or at least mitigate these impacts. Some of the programs are designed for the sole purpose of easing the impacts of environmental programs, others are intended to mitigate impacts from any kind of government regulation or action, and some provide assistance to those who need it regardless of the cause.

In 1977 CEQ established a task force made up of the various agencies involved in these programs to assess their current effectiveness and to recommend modifications. The CEQ–led task force found that although the existing programs seem adequate in most instances, they should be made more accessible to potential recipients. It therefore recommended that EPA appoint a full–time economic assistance officer in each of its regional offices and establish a full–time economic assistance support group in its central office to serve as a focal point for identifying potential problems as early as feasible, providing information on the availability of assistance programs to those potentially affected, and coordinating and facilitating the delivery of assistance to qualified recipients.[48] The task force concluded that the programs for firms and communities are probably adequate but that they are not delivering assistance efficiently and effectively.

ASSISTANCE FOR BUSINESSES

Small firms (generally those employing fewer than 250 people) can obtain assistance to buy pollution control equipment from the Small Business Administration, the Economic Development Administration, and the Farmers Home Administration. The SBA can make direct loans to small businesses, when commercial loans are unavailable, for implementing improvements required by federal pollution control legislation. SBA loans are currently being made at 6.65 percent for up to 30 years. The SBA also has a small program for the issuance of guaranteed pollution control revenue bonds, which can be used to finance any type of pollution control equipment. These tax–exempt bonds, issued through state or political subdivisions, can be sold at a lower interest rate than other com-

mercial bonds. In both programs the Environmental Protection Agency has to certify that the equipment is needed to comply with federal pollution control regulations.

Businesses can also obtain indirect assistance from the EDA, which is empowered to make grants available to local and state governments in economically depressed areas in order to increase economic activity and employment. The local governments can use the funds to make improvements in existing pollution control facilities, or they can lend the funds to firms for pollution control or for other purposes that will help the community's economy. In addition, the EDA has recently established a special loan guarantee program to assist the steel industry. These guaranteed loans can be used by steel firms to install pollution control equipment.

Larger businesses do not usually benefit from the special programs described above, but they do make substantial use of Federal Tax Code provisions that allow them to obtain funds from "industrial revenue bonds" issued through local or state governments. Because the interest payments on these bonds are exempt from federal taxation, they can be sold at lower interest rates than other commercial bonds. Repayment of the bond is tied solely to the firm; it is not guaranteed by the general revenues of any government. Funds raised must be spent for meeting federal pollution control requirements.

Other special provisions in the Tax Code can benefit private firms making pollution control investments. In the past, firms had a choice of taking either a 5–year amortization for certified pollution control equipment or the standard investment tax credit available for all qualified investment. The amortization provisions—generally less favorable than the investment tax credit and depreciation allowance—were rarely used. However, the Tax Reform Act of 1976 (P.L. 94–455) allowed firms to claim both the 5–year amortization and one–half the investment tax credit allowed, up to 5 percent, for all qualified investments. The President's 1978 tax proposals included a further liberalization which would allow firms to take the full investment tax credit along with the 5–year amortization;[49] the President's program also proposed the elimination of the industrial revenue bonds.

EPA's municipal waste water construction grants program also provides important financial assistance. The law requires firms connected to federally supported treatment systems to pay their share of the federally subsidized portion of the initial investment in the system. The repayment provisions are equivalent to a 30–year interest–free loan.

FARMS

The Small Business Administration and the Farmer's Home Administration have special programs to assist farms in controlling pollution. The SBA business loan program is also available to farm-

ers when commercial loans cannot be obtained. Through the Agricultural Conservation Program, farmers can receive government cost-sharing assistance, ranging from 30 to 90 percent of total costs, for efforts to implement approved pollution control practices (assistance to an individual farmer is limited to $2,500 per year). Assistance is also available through the Soil Conservation Service to control erosion and storm water runoff. Various other smaller programs can assist in such areas as water, flood prevention, farm animal waste disposal, and protection of wildlife.

COMMUNITIES

Several agencies can support community planning efforts related to pollution control and economic impacts. The Economic Development Administration and the Farmer's Home Administration can provide economic assistance to help implement these plans, and other agencies can provide grants or loans to construct the public infrastructure which may be called for in the plans. FmHA loans for waste water treatment are available to communities with populations under 10,000.

EDA can make loans to communities for subsidizing pollution control expenditures of firms that locate in economically depressed areas. EDA can also make grants to communities which in turn can loan the money to firms in financial trouble because of pollution-related expenditures. The aid may keep the firm in operation and thereby save jobs. Local governments may also use the liberal repayment provisions for firms connected to federally financed municipal waste water treatment facilities to attract or assist businesses.

The major purpose of the construction grants program is to reduce the financial impact of pollution abatement requirements on the communities. The federal government provides 75 percent of construction costs, with local governments, state governments, and the firms that will be using the facilities paying the remainder of the construction costs. When a community cannot obtain financing for the local share on reasonable terms and when there is reasonable assurance of repayment, loan guarantees are available.

WORKERS

The only direct pollution control assistance to workers is the legislative provisions protecting them from dismissal for helping enforce pollution control laws.[50]

An attempt was made to include special provisions for employee assistance in the 1977 Amendments to the Clean Air Act, but they were modified so that only a study is called for. The Congress included very strong provisions in legislation expanding Redwood Park to protect loggers and sawmill workers whose jobs would be affected by the Park expansion.[51] These provisions included preferential hiring for Park jobs, extended unemployment benefits (up to

6 years for most employees but up to 11 years if the worker is over 54 years old) at a rate equal to or higher than the worker's maximum income before being laid off, retraining benefits, and relocation benefits. Otherwise, workers who lose their jobs because of environmental protection programs do not have any more access to unemployment, retraining, and other such benefits than any other unemployed worker. However, the Administration is currently considering the desirability of a general program providing special assistance to workers affected by environmental programs. Arguments for such a program are based on the principle that if the federal government is implementing programs that create unemployment as a side effect, it has a special responsibility to help the people affected.

On the other hand, there is concern about the fairness of providing special assistance to some groups of unemployed workers and not to others and about the feasibility of efficient administration of such a program. The administrative issues include the question of how one identifies the cause of unemployment when there is not a single cause. As mentioned earlier, most establishments which threaten closure because of environmental restrictions are marginal to begin with, and it is difficult to determine the relative importance of the environmental factors. If special programs were available, there would be an added incentive for people to claim environmental programs as an important contributing factor, compounding the difficulty of administration. There is also the question of whether such assistance should be extended to workers indirectly affected by the program—for example, the truck driver who is laid off because his firm has lost business as a result of the closure of plants that it formerly supplied. Further, it can be argued that in some cases the most efficient method of assisting workers is to prevent the plants which employ them from closing and that the focus should be on helping firms to remain in operation rather than attempting to help the workers after they are unemployed.

STEPS TOWARD REGULATORY REFORM

With the increased concern about inflation, unemployment, and the balance of payments, increased attention has been given to the economic implications of government regulatory programs. Part of this effort is focused on reviewing long–standing economic regulatory programs such as those for monopolies, transportation, and communications. Part is focused on reviewing the implementation of the newer regulatory programs which are primarily directed toward such social issues as environment and worker protection. The regulatory reforms are intended to make the regulation development process more efficient, comprehensive, and open to the public.

Implementation of the newer programs is fomally reviewed by the Regulatory Analysis Review Group, established by the President

on a 6–month trial basis and chaired by the Council of Economic Advisers. Members of its Executive Committee include the Office of Management and Budget and, on a rotating basis, another economic agency (e.g., Treasury Department) and one regulatory agency (e.g., EPA). At the time that an agency proposes a major regulation, it prepares a regulatory analysis assessing impacts of the proposal and principal alternatives. The Council on Wage and Price Stability reviews these analyses and reports to the RARG on the more significant or controversial ones. The RARG Executive Committee then votes on which of the actions should receive intensive RARG review, with a maximum of 4 reviews per agency and a total of 20 within 1 year.

For the reviews that are conducted, the RARG comments are to be filed with the regulatory agency during the public comment period. The process is not supposed to delay regulations, and the RARG has no authority to order any changes, although the CEA Chairman can discuss the issues with the agency head or raise issues with the President.

Since this process was instituted early this year, the RARG Executive Committee has considered three EPA regulations. Because the Committee determined that EPA had sufficiently analyzed the impacts and considered them carefully, it decided not to review intensively either the regulations on synthetic organic chemicals in drinking water supplies or the guidelines for pretreatment of discharges into muncipal sewage treatment systems by electroplaters.

The RARG did evaluate EPA proposed regulations on the prevention of significant deterioration of air quality in clean air areas. The issue was raised after the public comment period had closed, and numerous discussions were held at all levels of EPA, CEA, and CWPS. This dialogue convinced EPA that some changes should be made in EPA review procedures for smaller sources (less than 50 tons of emissions per year). The result was a more streamlined review process which will apply to more than one–half the regulated plants. No significant increase in emissions is expected. EPA also clarified its instructions to states as a result of the CEA and CWPS comments but did not accept other proposed modifications, believing that they would not have been consistent with the intent of the Congress.

Table 10-4

Estimated Total Pollution Abatement Expenditures, 1977–86

(billion 1977 dollars)

	1977			1986			Cumulative (1977–86)			
	Operation and maintenance	Capital costs[1]	Total annual costs[2]	Operation and maintenance	Capital costs[1]	Total annual costs[2]	Capital investment	Operation and maintenance	Capital costs[1]	Total annual costs[2]
Air pollution										
Public	0.3	0.2	0.5	3.1	1.3	4.4	7.3	21.7	8.6	30.3
Private										
Mobile[3]	2.5	3.0	5.5	1.4	7.7	9.1	51.2	21.3	58.3	79.6
Industrial	2.3	2.8	5.1	4.2	5.7	9.9	26.7	32.8	42.2	75.0
Utilities	1.7	1.3	3.0	5.9	4.4	10.3	25.3	36.0	27.0	63.0
Subtotal	6.8	7.3	14.1	14.6	19.1	33.7	110.5	111.8	136.1	247.9
Water pollution										
Public	3.0	8.9	11.9	7.4	17.6	25.0	65.3	52.9	141.6	194.5
Private										
Industrial	2.2	1.6	3.8	5.9	4.6	10.5	30.2	39.4	30.1	69.5
Utilities	1.2	0.7	1.9	2.2	1.3	3.5	6.2	17.2	10.3	27.5
Subtotal	6.4	11.2	17.6	15.5	23.5	39.0	101.7	109.5	182.0	291.5
Radiation[3]										
Nuclear powerplants	<0.05	<0.05	<0.05	<0.05	0.1	0.2	0.2	0.1	0.3	0.4
Solid wastes										
Public	2.3	0.4	2.7	2.5	0.9	3.4	5.4	23.5	5.6	29.1
Private	4.4	1.0	5.4	6.1	1.6	7.7	6.9	53.6	11.4	65.0
Subtotal	6.7	1.4	8.1	8.6	2.5	11.1	12.3	77.1	17.0	94.1
Land reclamation										
Surface mining	0.1	NA	0.1	0.8	NA	0.8	NA	6.0	NA	6.0
Toxic substances[3]	NA	NA	NA	0.2	NA	0.2	NA	1.2	NA	1.2
Noise[3]	NA	NA	NA	0.4	0.5	0.9	3.0	2.0	2.2	4.2
Total	20.0	19.9	39.9	40.1	45.7	85.9	227.7	307.7	337.6	645.3

NA = Not available

[1] Interest plus depreciation.

[2] Operation and maintenance costs plus capital costs.

[3] Incremental costs and total costs are assumed to be the same.

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   It was the rapid, continued degradation of the environment during 1963–67 that stimulated the adoption of the federal pollution control legislation of the early 1970's. We conclude that spending would have to total more than $25.0 billion just to stay even, a figure that is more than one-half the total.
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CHAPTER 11

THE GLOBAL ENVIRONMENT

In keeping with its responsibility to provide information about environmental issues and trends with worldwide implications, the Council is giving special attention in this Annual Report to a critical concern for every continent—the relationship between economic development and environmental quality in the Third World. Through our long-standing commitment to providing economic aid to developing nations, the United States has recognized that development is essential for the improvement of living standards and quality of life for the world's poorest peoples. In recent years the federal aid–giving agencies—along with United Nations agencies, the World Bank, a growing number of multinational public and private organizations and the developing nations themselves—have also acknowledged the equally important fact that economic development cannot succeed unless development planning includes careful attention to the natural environment. Short–term increases in food production through irrigation and other technologies cannot vanquish world hunger problems if they are achieved at the expense of the long–term productivity of the land. Disease control programs cannot work if they depend exclusively on massive use of pesticides that have harmful effects of their own or lose their effectiveness as the target organisms develop resistance to them. Urban housing programs can do little to improve people's lives if the cities to which people flock cannot provide basic human necessities such as clean water, sewage disposal, and fuel for heating and cooking.

The environmental problems of developing countries divide into two related categories: those that have their roots in the poverty and lack of basic amenities and those that occur as side effects of the development process itself. The chapter describes both, looking first at the challenge of retaining adequate productive land to provide people with their food and livelihoods, then at the need to protect the diverse wild species with which people share the earth's resources, at the task of meeting ever–growing needs for clean water and freedom from waterborne disease, and at the special problems of the developing urban and industrial environment.

Following the discussion of environment and development, the chapter notes more briefly the major environmental events of 1978

on the international scene. They include changing population trends, the record oil spill from the tanker *Amoco Cadiz,* and international meetings and agreements dealing with Antarctic fisheries conservation, Law of the Sea, transboundary air pollution, energy, and resource management.

ENVIRONMENT AND DEVELOPMENT

PROLOGUE

Economic Growth and the Quality of Life

Economic indicators for a nation offer important clues to the quality of life in a country. Looking at the 18 countries with per capita gross national products lower than $100, we find that those countries record the highest infant mortality rates and the lowest life expectancies in the world. Not surprisingly, this group of nations also suffers from the lowest per capita protein consumption and the highest population per physician. Literacy, too, is at its lowest here.

Table 11–1, drawn from World Bank statistics, illustrates the general correlation between GNP levels and these measures of social and physical well–being. Conclusions must be drawn cautiously, however. Circumstances are unique in each country, and many other elements besides gross national product affect the condition of a nation's people. But the table does illustrate two important points: that millions of people lack access to life's basic necessities—adequate food,

Table 11-1

Selected Social Indicators for Groups of Nations, 1970

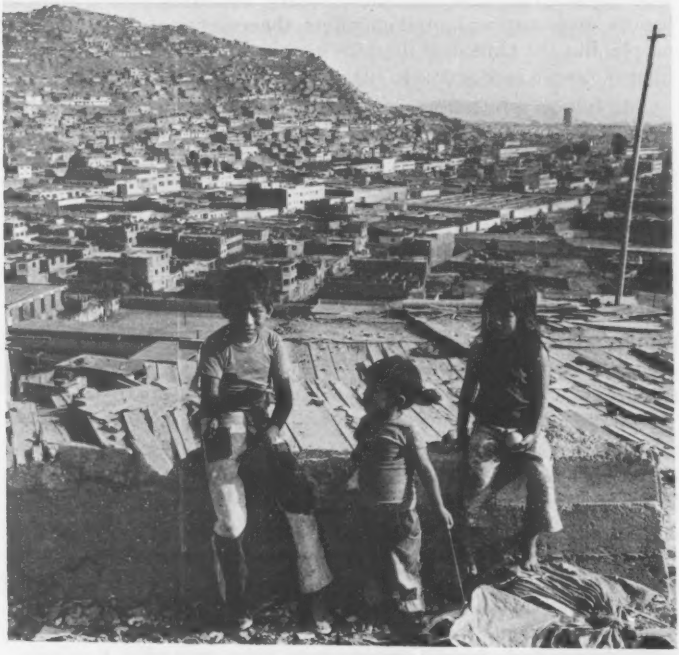
Per capita GNP group	Infant mortality (per thousand live births)	Life expectancy at birth (years)	Average per capita daily protein consumption	Population per physician	Adult literacy (percentage)
$100 and below (18 nations)	[1]159.5	43.7	56.5	21,820.5	NA[2]
$101–200 (18 nations)	113.1	46.5	57.7	8,878.5	NA[3]
$201–375 (26 nations)	100.2	55.9	59.3	3,436.5	43.1
$376–1,000 (26 nations)	55.6	61.4	68.2	1,729.4	70.3
$1,001 and above (30 nations)	19.1	71.6	89.4	715.6	97.6

[1] 1970 figures not available; 1960 figures used instead.

[2] Limited available national statistics range from 5 percent for Upper Volta and Somalia to 56 percent for Indonesia.

[3] Limited available national statistics range from 15 percent for Sierra Leone to 85 percent for Sri Lanka.

Source: World Bank, "Social Indicators," *World Tables* (Washington, D.C., 1976).



Barriada El Augustine—a typical Lima slum.

shelter, health care, and education—and that the gaps between rich and poor nations are very great.

Economic development combined with measures to improve social equity offers hope for a better life for the poorest people in the world. Recent experience offers some grounds for optimism despite continuing concern over discouraging trends. Reviewing recent economic growth statistics in an address to the World Bank's Board of Governors, Robert McNamara reported that the average GNP growth rate for developing countries in 1976 was 4.7 percent. Over the third quarter of the century, the growth rate for developing nations averaged 3 percent per year, compared with 2 percent annually in the industrialized nations. McNamara conceded that the income gap between rich and poor nations has not yet begun to close but that the "quality of life gap" is shrinking. Improvement is evident in nutrition, literacy, life expectancy, and other social indicators.[1]

Some leaders in the development field, sharing McNamara's view that measurements of gross national product fail to describe adequately the real condition of people, have begun to develop alternative yardsticks. The Overseas Development Council, for example, has created a composite Physical Quality of Life index (PQLI) by combining literacy rates, life expectancy, and infant mortality figures for individual countries and ranking them on a scale from zero to 100. The results, as shown in Table 11–2, indicate that PQLI achievement does not necessarily correlate directly with per capita GNP levels.

Table 11-2

GNP and the Physical Quality of Life

National income	Average per capita GNP (dollars)	PQLI[1] achievement
Lower	152	39
India	140	41
Kerala, India	110	69
Sri Lanka	130	83
Lower middle	338	59
Malaysia	680	59
Republic of Korea	480	80
Cuba	640	86
Upper middle	1,091	67
Gabon	1,960	21
Iran	1,250	38
Algeria	710	42
Taiwan (Republic of China)	810	88
High	4,361	95
Kuwait	11,770	76
United States	6,670	96
Netherlands	5,250	99

[1] Physical quality of life index.

Source: Overseas Development Council, *The United States and World Development: Agenda 1977* (New York: Praeger Publishers, 1977), p. 150.

Unfortunately, about half the people in the developing world have failed to enjoy the benefits of recent improvements in income and quality of life. Economic growth is slowest in the 32 poorest countries with an aggregate population of 950 million—46 percent of the Third World population. The growth rate in per capita income has declined in these countries from 2.6 percent annually in the 1950's to only 1.1 percent in the first half of the 1970's, resulting in a 1950–75 average rate of 1.5 percent.[2] As a result, the gaps which persist between the poorest and the most advanced of the developing countries are on the same scale as those between the developing nations as a group and the industrialized world. It becomes increasingly misleading, in fact, to speak of the "developing nations" as though they were a monolithic group. Their diversity and range of income cannot be overemphasized.

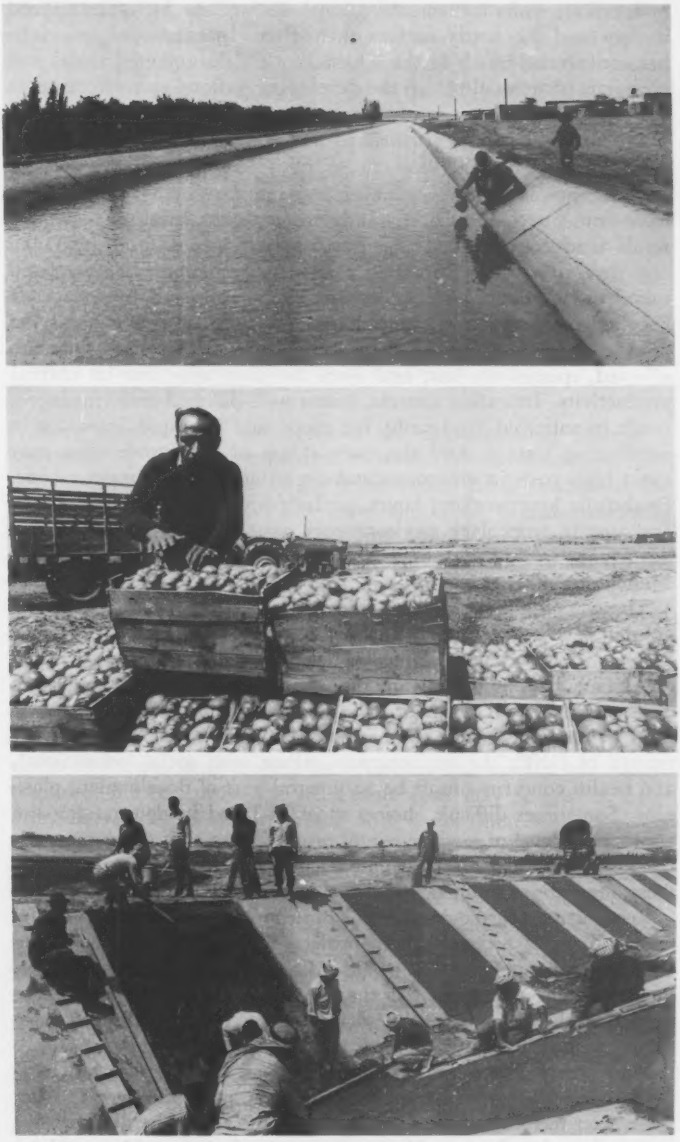
Within individual countries, the discrepancies between the poorest and most affluent people can also be enormous. Some oil–rich nations have per capita gross national products as high or higher than the United States, but only a tiny fraction of this wealth reaches their poorest citizens. A similar imbalance is found in developing nations that have experienced rapid growth in industry and urban settlements in recent years, particularly in Latin America. Learning how to reach the very poor with the benefits of development is a continuing challenge for national governments and international aid agencies.

This lack of progress in many places means that 1.2 billion of the world's 4 billion people continue to lack access to safe water supplies and public health facilities, 700 million remain seriously malnourished, 550 million still cannot read or write, and 250 million who are living in urban areas lack decent shelter.[3]

World Poverty and the Physical Environment

The physical environment surrounding the poor is inevitably abused. People at the margin of existence cannot afford the luxury of conserving for the future but must take wood for fuel and heat where they find it, let livestock graze on whatever land there is to be found, and work the land to exhaustion in putting food on their tables. Forests are stripped, land erodes, and water is polluted with wastes. These are the environmental problems of poverty. Their cure is found ultimately in the gradual elimination of poverty itself, through development that is planned with environmental soundness as one of its objectives.

Human welfare is intimately tied to such measures as the productivity of agricultural land, the availability of clean water, and the abundance of natural resources. People can be helped greatly by the extension of irrigation, construction of water supply and waste treatment facilities, improvement of cultivation methods, and conservation of resources. Projects to supply these benefits are financed regularly by multilateral aid agencies (such as the World Bank, regional development banks, organizations affiliated with the United Nations,



The East Ghor Canal in the arid Jordan Valley has raised the region's farm production dramatically, and tomatoes have become a leading cash crop. This 300–mile canal and ditch irrigation system will have to be carefully managed to avoid problems of waterlogging and salinity.

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and private voluntary organizations) as well as by industrialized nations and the needy nations themselves. International assistance has contributed much to the Third World's documented social and economic progress although the developing nations' own efforts have accomplished the most impressive gains.

Hazards of Development

In recent years, however, developed and developing nations alike have come to recognize that adverse environmental impacts can result inadvertently from the development process itself and can endanger its results. Efforts to plan development projects around sound environmental principles are often hampered by a lack of knowledge, inadequate financial resources, or conflicting goals. As land is cleared and exploited for agriculture, wildlife and flora are affected, species are lost, and even the land may lose its natural productivity. Irrigation systems, unless well–planned and –managed, result in salinized land unfit for crops and in rapid increases in debilitating disease. And the early stages of industrialization may exact high costs in environmental degradation and human misery. Frightfully long working hours, pitifully low wages, and unhealthy and unsafe workplace environments exist in many cities of the developing world today as surely as in the "dark satanic mills" of Manchester 150 years ago.[4]

The complex and delicate relationship between environment and development was addressed explicitly in the well-known Founex Statement, issued by a group of economists from developed and developing nations in 1971 in preparation for the UN Conference on the Human Environment. The Statement said that development must be considered in a context considerably broader than just the growth of GNP; the environment—along with social, educational, and health concerns—must be an integral part of development planning. Sometimes difficult choices must be faced in determining the appropriate level of environmental protection so that development is not impeded. Only the developing nations themselves can evaluate these alternatives and make final decisions.

Recognizing that environmental protection sometimes adds to the financial cost of a development project, the Founex Statement also warned against policies that would place most of this new burden on the developing countries: "If the concern for human environment reinforces the commitment to development, it must also reinforce the commitment to international aid." [5]

Many years' experience with international development aid indicates that well-intended improvement measures sometimes fail because their recipients fail to receive—in some cases, even to perceive —their benefits. Impoverished villagers in India or Upper Volta may resist the advantages of environmentally sound energy projects designed to reduce their dependence on scarce firewood because they see the new system as a loss of valued self-sufficiency and an increase in the economic and social power of the government or

private authority which delivers the alternative energy. Similarly, adults in poor societies with high infant mortality rates and primitive farming methods often value large families because they ensure an adequate supply of agricultural labor for the family. Such people resent and resist population control programs which they perceive as detrimental to their interests, particularly when family planning services are delivered in coercive or heavyhanded ways without accompanying economic or social benefits. To avoid exacerbating existing social and economic inequities, then, aid-giving organizations and governments must exercise a high degree of sensitivity to the needs and values of poor people. Planning for economic development must include full consideration of potential effects on the natural and social systems that make up the human environment.

Toward a Balanced Approach to Development and Environmental Protection

Some international aid agencies are demonstrating increasing awareness of their responsibility to reconcile environmental and developmental objectives. In 1970 the World Bank established the post of Environmental Adviser (now the Office of Environmental and Health Affairs) to review pending financing projects for their environmental implications and to design safeguards when needed to avoid adverse side effects. In the first 30 months the new procedures were used, the Bank reviewed 434 projects. Twenty-four of them subsequently required special studies by outside consultants, and environmental protection measures were carried out. Contrary to early predictions that these actions would greatly increase the cost of the projects, the Bank reports incurring environmental protection costs amounting to from 0 to 3 percent of total project costs. The earlier in the planning process the environmental actions were taken, the lower the cost proved to be. Future costs may be greater, however, as nations develop further and desire increasing levels of environmental protection.[6]

The need for harmony between environmental and development goals has also received increased attention in the United States. In his 1977 Environmental Message, President Carter instructed the State Department, the Agency for International Development, and other concerned federal agencies to "ensure full consideration of the environmental soundness of development projects under review for possible assistance" and to provide special assistance and training to developing countries in the areas of environmental and natural resource management.[7]

AID has recently begun preparing environmental assessments and environmental impact statements on certain assistance programs and has taken steps to integrate environmental considerations into the early phases of project planning. Among the projects that AID has assessed for environmental factors since 1976 are land developments in Peru, tsetse fly control in Tanzania, integrated rural development in Liberia, and water and sewer development in Yemen.

Whether to provide foreign nations with toxic pesticides that are banned or restricted in the United States is an especially controversial example of the questions that have been faced. As a result of AID's programmatic impact statement on its pesticides program, the Agency is funding a number of new efforts in integrated pest management.

The guiding principle, clearly, is that social progress gained through economic development must be sustainable—meaning that the integrity of natural systems must be respected in the development process. Specific development issues illustrate this challenge.

LOSS OF PRODUCTIVE LAND: DEFORESTATION AND DESERTIFICATION

In the industrialized world, our crucial link with the thin layer of productive soil that provides food, building materials, recreation and beauty, and a portion of our energy is sometimes forgotten. The late Senator Hubert H. Humphrey felt it necessary to remind passers-by with a poster on his office door, "Agriculture is only as far away as your next meal." In the developing nations, by contrast, people's dependence on the land is both obvious and local; food and fuel production for rapidly expanding populations requires adequate amounts of productive land near where people live. Yet growing evidence suggests that in many parts of the developing world, vast expanses of land are being lost to human use, primarily through deforestation and its shadow, desertification. Further, the available evidence points overwhelmingly to the conclusion that people themselves are the major cause of desertification.

Causes and Extent of Deforestation

In most parts of the developing world, people routinely destroy trees and clear whole forests for agricultural use, fuel consumption, or timber exportation. Statistics on deforestation offer only the roughest estimates of the amount of clearing that occurs each year and even scantier information about the use of the trees involved. Yet figures derived from aerial and satellite surveys and other sources document the extent of the problem.

Clearing for agriculture is the single largest impetus for deforestation on a global basis, with fuelwood cutting second, and timbering for industrial uses third. Even in Africa, twice as many trees are felled for agricultural expansion as for fuel use each year. According to Reidar Persson, an expert on world forest resources, very rough estimates suggest that 1.3 billion cubic meters of roundwood are cut from African forests each year; of that amount, approximately 60 percent may be attributed to agricultural expansion, 30 percent to fuel use, and perhaps 10 percent to industrial use.[8] Quantitative information on a worldwide basis is still very scarce.[9]

It has been estimated that primeval forests covered over one-half

the land area of the world. Today some 4,000 million hectares (10 billion acres)—30 percent of the land—remains forested.[10] In some developing countries, over one-half of all land area is still forested, but dense and rapidly growing populations, combined with ever-greater requirements for wood fuel and food cultivation, are eroding this forestry base.

About 70 percent of forest land is classified as "closed forest"—mature woodlands with a closed canopy. While closed forest resources amount to 1.5 hectares (3.7 acres) per capita in the more industrialized nations, they amount to only 0.45 hectare (1.1 acres) in the less developed countries. An even greater discrepancy exists between the 2.8 hectares (7 acres) of forest per person that remain in North America and the comparable figures for Africa and Asia—only 0.5 hectare (1.2 acres) and 0.2 hectare (0.5 acres), respectively.[11]

The world's closed forest was reduced by more than 500 million hectares (1.2 billion acres), 15 percent, in the decade between 1963 and 1973.[12] In the less developed countries, forest depletion is occurring at a much faster rate; the Food and Agriculture Organization estimates annual losses at 5–10 million hectares (12–25 million acres) in Latin America and 5 million hectares (12 million acres) in Asia.[13] At this rate, the Third World could lose its entire forest resource base of 1.2 billion hectares (3 billion acres) in only 60 years or even less, if the pressures of population growth are taken into account.[14]

"The adverse effects of forest depletion are now most pronounced in developing countries," the World Bank forestry policy paper stated, "reflecting their typically greater population densities and more rapid population growth, their rural–based economies with large numbers of people with relatively low incomes, and their lack of conservation measures."[15]

Clearing for Agriculture Settlers throughout the world have converted billions of acres from forest to farmland since ancient times. The consequences have depended on the topography and the climate and on the care with which the land has been cultivated. Where the weather is moderate and the terrain relatively flat, agricultural yields have been sustained for centuries. But where steep slopes are cleared or the ground is exposed to intense heat and torrential rains, soils are quickly baked hard or eroded. Nutrients are leached below the root zone of annual crops, rendering the land useless. Without deep–rooted trees, the soil compacts still further.

Farmers familiar with this course of events have made shifting cultivation a way of life. They move on to "slash and burn" new woodlands every few years, whenever their current agricultural plots are exhausted. Eventually, if the land is left fallow, bush and trees grow back and the soil regenerates as new vegetation restores nutrients and breaks up the compacted earth. Then the cycle is repeated.

The pressures of population growth in many areas are forcing people to clear again before the forest fully recovers. Under this

extra pressure, the land loses its ability to support any productive growth. Even under more favorable conditions, shifting cultivation is problematical because it requires an extremely large land area to provide food for even a sparse population.

Forest Devastation and Fuel In Ouagadougou, Upper Volta, forest depletion is illustrated in the utterly denuded circle around the urban center—some 70 kilometers wide—where all trees have been consumed for firewood.[16]

As the distance that fuel must be carried grows, the cost rises; currently the average Ouagadougou laborer spends 20 percent of his meager income (some $14 out of $70) for fuelwood each year.[17] In Bamako, Mali, and Niamey, Niger, the share of income spent for fuelwood is one–quarter. By contrast, the average family in the United States spent only 6 percent of its income to meet all its energy needs in 1973.[18] Bamako's population is expected to consume 100,000 hectares (250,000 acres) of forest land annually to supply its residents' fuel needs by 1990.[19]

In rural areas, firewood costs to the poor are measured in gathering time, rather than in money. Rural Indian families typically spend from 50 to 200 days per year cutting firewood, and the time grows as supplies become less and less accessible.[20]

As firewood becomes both scarce and expensive, efforts to find substitutes sometimes take on a desperate character. Poaching in forest preserves grows, and where whole trees are not taken, the bark is sometimes stripped for burning—a common practice in some parts of Pakistan—leaving the trees to die slowly. In Korea, people resort to sweeping the ground, thoroughly clearing the soil of all the underbrush and leaves that protect its fertility, stability, and moisture retention. For urban dwellers, the usual substitute for firewood is kerosene, but this petroleum–based fuel has quadrupled in price since the Arab oil embargo of 1973–74, putting it out of reach for most families in poor countries. It is likely that for the foreseeable future wood will continue to supply three–quarters of all fuel needs in sub-Saharan Africa and about one–half in Asia (compared with only 6 percent in the world as a whole and 1 percent in the developed economies).

On the Indian subcontinent, impoverished rural dwellers dry and burn animal dung as a substitute for fuelwood. This practice robs the soil of an invaluable natural fertilizer and structural stabilizer, hastening the time when even large doses of chemical fertilizer and applications of mechanical watering devices—if they were available —could not force the soil to produce food.

Timbering in the Third World The World Bank reports that less than one-third of the closed forest area in developing countries is subject to any form of timbering regulation and that the forest industry in these countries normally operates (at least initially) "as an extractive industry," with forests regarded as a resource to be "mined" rather than as a renewable crop for permanent production.[21] Private timbering enterprises usually achieve their greatest

financial rewards by exporting raw wood for processing in developed countries. This practice severely limits the economic benefits enjoyed by people in the countries where the forests grow.

The concept of forest management on a sustainable yield basis typically emerges as a policy directive from national governments (who own most of the world's forest lands) only after serious forest losses are suffered. In many countries, this approach is nonexistent or operative only on paper. In the less developed nations, "the failure to adopt a controlled forestry policy is attributable to a lack of political will, reflecting both a short–sighted view and a long-established primitive attitude toward forests," the World Bank has charged.[22]

Garrett Hardin, the noted biologist, offered a different perspective on the developing nations' willing participation in the destruction of their timber resources. Bearing in mind the wide discrepancies in the economic bases of rich and poor nations, Hardin notes that the " 'opportunity cost' to the rich country of the money it offers the poor country as bait is only a fraction of the opportunity cost of the same nominal sum to the poor. Consequently, the rich country can save its own resources by drawing on the comparable ones of the poor . . . . Starved for aesthetically desirable hardwoods, the rich countries painlessly offer sums of money that are irresistible to the poor." [23] In other words, timber purchases by the wealthy nations constitute offers that the less developed economies cannot refuse.

Environmental Consequences of Deforestation

The combined effect of farming, fuel cutting, and timbering in the Himalayan foothills has left naked slopes to erode in the annual monsoon season, causing frequent and widespread flooding in Pakistan, India, and Bangladesh and filling lakes and rivers throughout the lowlands with millions of tons of silt. The crushing burdens of property damage, crop failure, loss of life, and spread of disease from flooding add to the already critical food shortages in these areas of explosive population growth.

Erik Eckholm of the Worldwatch Institute has summarized the environmental consequences of all these deforestation trends: "The accelerating degradation of woodlands throughout Africa, Asia and Latin America . . . lies at the heart of what will likely be the most profound ecological challenge of the late twentieth century . . . the undermining of the productivity of the land itself through soil erosion, increasingly severe flooding, creeping deserts, and declining soil fertility." [24]

Remedies for Deforestation

Tree planting programs exist in many countries. China's is probably the most successful to date, but many problems—including low political priority, lack of trained manpower and local support, failure to protect young trees from foraging animals, worldwide recession, and crippling cost increases tied to world energy prices—

have prevented reforestation programs from keeping up with forest losses. The most fundamental problem behind the failure of reforestation programs, however, is the continued unavailability to poor people of the most basic requirements for living. They must gather firewood because they cannot afford kerosene. They must allow their animals to roam and feed among seedling trees because they have neither the land nor the money to feed their herds. The value of a forest that will not be mature for a decade or two appears understandably small to these people, compared with the value of firewood or grazing land today.

In Haiti, where the process of deforestation is virtually completed, reforestation requires removing land from agricultural use—an action that few subsistence farmers would welcome in this impoverished island nation. Haitian peasants cut seedling trees continually for slash and burn agriculture and for firewood. Joseph Wainwright of the Haitian Ministry of Agriculture observed: "The peasants are not wicked, and they are not vandals. . . . What they are is desperate. The combination of economic poverty, land scarcity, and growing population puts a relentless demand on the most inhospitable pieces of land.[25]

The impetus for forest regeneration must come from within the less developed nations, from the international aid agencies, and from developed nations with foreign aid programs. In an important shift in its forestry assistance policy, the World Bank has announced a new emphasis on "environmental forestry" (tree planting to prevent soil erosion, protect watersheds, and enhance soil fertility) and

This project at Ouayigouya, Upper Volta, is an attempt to reforest an area ravaged by a combination of economic poverty, land scarcity of usable soil, and growing population.

"rural development forestry" (establishment of village fuelwood lots and other small forest projects designed to benefit indigenous populations) to supplement its investments in industrial forest development.[26] The U.S. Agency for International Development expects in fiscal year 1979 to begin funding pilot projects in reforestation, soil conservation, and alternative energy sources (such as methane production from organic wastes) in Nepal. AID expects to undertake forest programs in five countries of Sahelian Africa in the near future and during fiscal year 1978 planned to finance small-scale renewable energy projects. These projects may include converting plants to fuel, using the sun for cooking or heating, and building small-scale hydropower dams. Such energy alternatives could help to reduce pressure on forests as a source of fuel.

A 1977 report of the United Nations Environment Programme suggested other ways in which small-scale "appropriate technology" can conserve forests. A number of simple changes in the ways in which people burn firewood could do much to stretch this scarce resource. Although only 6 percent of the heat value is captured in the usual wood cooking stove in Indonesia, stove design improvements can cut heat losses by 20 percent. Drying wood for several weeks before use can reduce waste another 10 percent, and cooking in a newly designed pot partially sunk into the stove can eliminate an additional 30 percent. If overall efficiency improvements averaged 50 percent, a 10-hectare (25-acre) fuelwood plantation cultivated with fast-growing species and carefully managed for sustainable yield could supply the fuel needs of an Indian village of 1,000 families indefinitely.[27] The major challenge in attempting to apply these ideas over broad areas, of course, is the difficulty of introducing lifestyle changes at the household level. Information must first be disseminated through scattered villages, but to gain acceptance, new stoves must cost less than the fuelwood saved.

U.S. government officials, along with experts from the private sector and from the Food and Agriculture Organization and the United Nations Environment Programme, discussed the deforestation problem at a U.S. Strategy Conference on Tropical Deforestation in Washington, D.C., in June 1978. Conferees recommended that AID make revegetation a key aspect of rural assistance programs, paying special attention to the critical need for wood fuel. Participants also called for additional expertise in renewable resources on AID's staff.

Desertification

International organizations have also begun to pay careful attention to one of the severe consequences of deforestation—a relentless process of "desertification" which is occurring at an increasing rate in the world's arid, semiarid, and marginal subhumid lands. A term too new to be precisely defined, "desertification" generally describes the gradual long-term reduction in the productivity of land

through the spread of desert–like conditions. This process may be envisioned as one of slowly advancing frontiers of sand, but in fact its spread looks more like a mosaic or patchwork quilt, with pockets of exhausted land continually emerging in the midst of arable regions until an entire region can be classified as desert.

A World Map of Desertification, prepared for the UN Conference on Desertification convened in 1977 (Figure 11–1), shows that most of the world's drylands are considered to be at "high risk" or "very high risk" of losing their ability to support useful species of plant and animal life. As much as 30 percent of the earth's land surface, covering parts of 100 nations and occupied by one–sixth of the world's population, is designated as at least "threatened." [28]

Desertification strikes developed nations too, but its costs are felt most acutely in the poorer regions of the world. The United Nations has documented examples in Sahelian Africa, Chile, India, Tunisia, Iraq, and Pakistan,[29] but the World Map of Desertification shows that a threat exists in lands as diverse as the United States, Australia, Spain, Yemen, Turkey, China and Brazil, to name only a few.

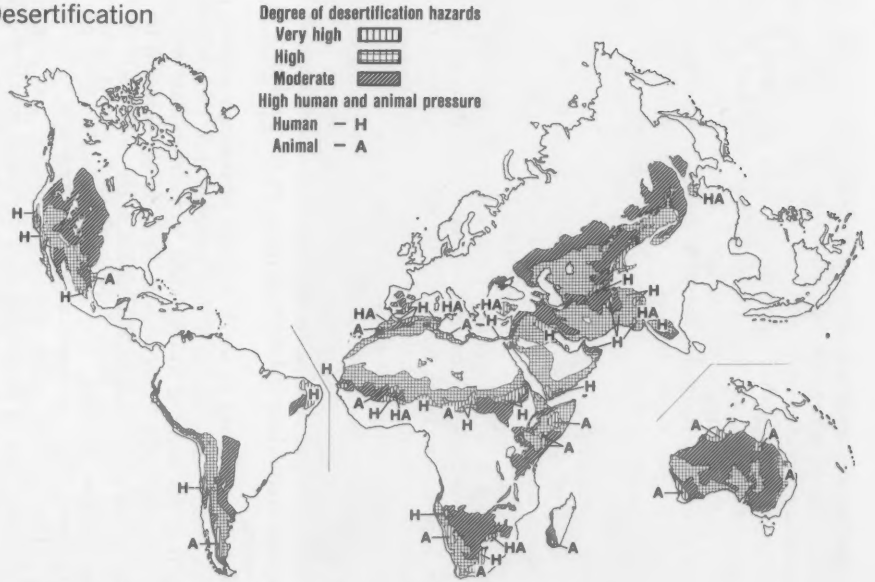
A report prepared for the UN Conference concedes that statistics on desertification, like those on deforestation, represent only knowledgeable guesses by the experts. But the implications of available figures are staggering. The report noted that some authorities believe that land is now being degraded through desertification at the rate of 50,000 square kilometers a year; it concluded with this prognosis: "Estimates of present losses give rise to a pessimistic outlook, suggesting that the world will lose close to one–third of its arable lands by the end of the century." [30] This possibility is all the more distressing in light of the UN report estimate that feeding the world's growing population in the last years of the 20th century will require food production to increase by one-third just to maintain current standards of nutrition. Further, as many as 50 million people out of the total dryland population of 600–700 million already face the threat of the loss of their livelihoods through desertification, the report said.

Human Impacts on Fragile Arid Lands The world's drylands offer difficult and unreliable environments to those who inhabit them, and when human use of these areas fails to take account of their delicate ecosystems, desertification results. Annual rainfall statistics tell only part of the story: Lands considered "arid" receive up to about 20 inches of precipitation per year, "semiarid" lands up to 45 inches, and the "subhumid margins" up to 60. More significantly, drier climates also experience great seasonal variation in rainfall, with most of the year's precipitation concentrated in a few months or even weeks. Quantities vary greatly from year to year as well, in cycles that bring crippling droughts to many regions once or twice in a lifetime and moderate droughts much more frequently.

Climatologists have surveyed conflicting evidence of long–term climate change and of human impacts on the trends toward warm-

Figure 11-1

World Map of Desertification



Source: ©Food and Agriculture Organization of the United Nations and the United Nations Educational, Scientific and Cultural Organization.

ing or cooling and drought or excessive rainfall; unfortunately, their efforts have failed to produce clear answers or useful prognoses. The experts do agree, however, that human activities are causing acute local changes in the productivity of arid and semiarid lands. People, not climatic changes, are the principal identifiable cause of desertification. One important way that we contribute to long-term desertification is by increasing livestock and cultivation during the high rainfall years to levels that cannot be sustained—and can accelerate the breakdown of thin dryland soils—in average or drought years.

Almost by definition agriculture in arid and semiarid regions pushes the land to the edge of its productive capacity and involves a constant gamble with a capricious climate. When the gamble is lost, the soil may be baked into a cement-like crust, or it may wash or blow away. Loss of perennial plant cover and livestock, crop failures, famine, disease, and massive migration to relief centers follow in periods of acute drought. The return of normal rainfall may bring a gradual regeneration and allow people to rebuild herds and return to farming. But often a portion of the land loss proves to be permanent. Then the area which remains for grazing or cultivation becomes more densely used, and some people who have fled to cities remain there. Tragically, the cycle is almost certain to begin again, with overstocking and overcultivation on marginal lands in the good years.

"Under the pressures to which they are increasingly subject, pastoralists sometimes behave as if they regarded their breeding stock, rather than the land and its vegetation, as their ultimate resource," the U.N. report said. "This leads to an apparent disregard for the ecology of the plant communities on which the stock feed." [31]

The Sahelian Drought The African Sahel, just south of the Sahara Desert, offers the most dramatic recent example of the devastating effects of both acute short-term drought and long-term desertification. Four of the world's least developed countries—those with per capita gross national products of less than $100—are in this region. After several years of above average rainfall, precipitation in the Sahelian zone dropped to less than one-half the norm each year between 1968 and 1973. In Niger, as in other Sahelian countries, including Sudan, Mali, Upper Volta, and Chad, the devastation of drought was exacerbated by a predrought buildup of livestock, extension of cultivated lands, increase in population, and change in living patterns away from nomad pastoralism (with low animal and human densities) toward sedentary livestock raising and farming centered around watering places.

Ironically, the development of large central watering holes fed by deep wells had resulted from earlier aid programs sponsored by such agencies as the World Bank, the Agency for International Development, and the Food and Agricultural Organization. Although planners of these projects intended that grazing around the watering holes be strictly regulated to prevent overgrazing, making

Desertification in Niger.

this happen was less easy than the technical task of providing water. Quite simply, according to a case study of Niger prepared for the UN Conference on Desertification, "it proved impossible to refuse water to herdsmen," and grazing loads soon reached levels two or three times greater than the ground could sustain.[32] Cattle were soon dying, not from lack of water—the water holes continued to provide that—but from starvation. "The cumulative effects of trampling and of grazing during the wet season (before seed-set) resulted in devastated areas extending 10–12 km around watering points, beyond the grazing range of cattle under stress."

As the drought worsened, herd losses in some parts of Niger exceeded 80 percent in 1972,[33] and the cost in human terms began to unfold before the world via satellite–transmitted television. International relief agencies and national governments provided emergency food shipments to the relief camps where thousands fled, but not in time to prevent 100,000 deaths in the Sahelian countries.[34]

Perhaps the most distressing aspect of the Sahelian tragedy is the possibility that it could occur again. One international effort, established independently but endorsed by the UN Conference, seeks to prevent such a recurrence. Called SOLAR (Sahel Livestock and Rangelands Management), this cooperative program, involving Chad, Mali, Mauretania, Niger, Senegal, Sudan, and Upper Volta—with assistance from donor nations, including the United States—will attempt to alter range practices so that some livestock raised on

the Sahelian rangeland by nomads are moved southward to more rain–abundant regions for final fattening and marketing.[35] This policy must be carried out by individual nations working quite literally at the grass roots level with nomadic herders and with the ranchers who will prepare the cattle for market.

Recommendations of the UN Conference on Desertification The UN Conference on Desertification produced a Plan of Action To Combat Desertification, with recommendations for national, regional, and international measures. The Plan outlines a variety of technical approaches suitable for different ecological zones and land uses, and the 32 case studies prepared for the conference document experience with many more.

Implementation of the 28 specific recommendations will involve varying degress of difficulty; they range from a call for careful monitoring and wide publicizing of the desertification problem to the introduction of significant changes in planning and management of land use and water resources. In some respects, the proposed actions comprise a wish list—for example, "It is recommended that governments should take all necessary steps to ensure the conservation of flora and fauna in areas subject or likely to be subject to desertification." [36] Others reflect the delicate diplomatic considerations which are a part of any effort to foster international cooperation on matters of environment, population, and economics: "It is recommended that countries which so wish should adopt economic and demographic policies that will support programmes for improving land use and sustaining the productivity of agro–ecosystems in dry lands, including, as appropriate, maintenance of an adequate rural labor force, sedentarization of nomads and resettlement of migrants from rural to urban areas." [37]

An important recommendation of the Conference calls for the establishment of national desertification commissions charged with developing national plans to combat the problem. Thus the UN Action Plan recognizes that solutions to the desertification problem lie primarily in eliminating institutional, social, political, and economic constraints which impede the use of currently available technology. The magnitude of the problem is such, however, that the Action Plan appears far from adequate to overcome these obstacles. Desertification must be expected to worsen until a much greater commitment to its reversal emerges within the international community.

WILDLIFE: ECONOMIC OPPORTUNITIES AND ECOLOGICAL CONTROVERSIES

Protection of wildlife—particularly the 10 million large mammals for which Africa is famous—is another issue which relates closely to the problem of finding and keeping enough productive land to support rapidly growing, impoverished populations and the domestic animals on which they depend for food. The Serengeti National

Park in Tanzania exemplifies both the problems and attempted solutions. Since the Park was established by the British Government in 1940, competition for territory has raged between the animals' protectors and indigenous people who had long coexisted with the wildebeests, lions, zebras, hippos, elephants, and other creatures inhabiting the Park.

The debate about wildlife in Africa tends to disintegrate into accusations of villainy on both sides, but in fact the concerns of both those who champion the animals and those who see them as a threat to the well-being of people are compelling. The dilemma, as Harold T.P. Hayes described it, boils down to a question of which is more important, to "save Serengeti now for its value to the future, still locked tenuously within its borders, or utilize it by whatever means for the growing need of hungry people just outside it?" [38] The question exists not only for Serengeti—where approximately one-fifth of the large African mammals live—but for other wildlife preserves as well.

The Importance of Wildlife

Worldwide enthusiasm for Africa's wild beasts and for wildlife in other ecosystems reflects the fact that wildlife and wild habitats are biological and cultural treasures that belong, in a sense, to mankind as a whole and to future generations as well as to the current one. The experience of viewing wild mammals, birds, and reptiles in their natural habitats may be accessible only to a relatively small number of people. The rich diversity of wildlife and the ecosystems that support it are viewed by scientists as intimately connected to the long-term survival of humankind. "Man's egocentric fantasy world continually distracts him from the basic biology of his existence," Thomas Lovejoy of the World Wildlife Fund wrote. "Species are essential for healthy ecosystems, which in turn are fundamental to the maintenance of the planet's carrying capacity for man and all life." [39]

The Costs and Benefits of Wildlife Protection

Much of this shared wildlife resource is found in the developing countries. Its protection for the benefit of people throughout the world sometimes poses difficult economic decisions and often requires the commitment of financial resources that exceed the capability of these countries. In a recent report prepared for the Council, the Worldwatch Institute recommended creation of a global cost-sharing scheme under which the wealthier nations would contribute to the cost of protecting wildlife and the ecosystems that support it in the poorer regions of the world.[40]

Wildlife resources also offer economic benefits to many nations. Tourism, based almost entirely on the wild animals, is a principal source of foreign exchange for Kenya. Although tourism fluctuates with the cycles of prosperity and recession throughout the world, tourist dollars have been particularly important in newly indepen-

dent east African countries that have not yet built enough indigenous industries to handle their economic needs.

Human Encroachment in African Wildlife Habitats

Short–term threats to the survival of wild African game include competition from cattle for food at the edges of the great parks and the nearby watering holes, the creeping expansion of farms along park borders (sometimes blocking important migratory paths), and the guns and traps of poachers, who take tens of thousands of animals from game parks each year.

Nearby tribes often see poaching as a means of surviving in a difficult environment. Populations of some of these tribes are growing at the rate of 3.5 percent annually, and they face territorial limits imposed by the park boundaries on one side and a number of natural barriers on the other. Their cultivated plots and grazing lands suffer increasingly from desertification, particularly during droughts. Their farming efforts are often frustrated by damage caused by trampling elephants and other animals who fail to respect the arbitrary park boundaries. At least one expert believes that agricultural damage caused by wild animals in Kenya costs twice as much each year as the amount of money brought in by tourists and that the poorest pastoralists and farmers are bearing those costs.[41]

The Tanzanian government has attempted to resolve the Serengeti conflicts within the context of overall development strategies involving the resettlement of millions of people into "development villages." These villages are carefully placed away from the park borders, leaving a buffer zone of 8–14 kilometers in which people are not allowed to live or farm, although they may enter each day with their cattle for grazing. Only the experience of many years will determine whether this program will protect the animals and their habitat without creating intolerable overcrowding pressures on the nearby human populations.[42]

The Cropping Debate

A second controversy involving wildlife and habitat protection involves the practice of "cropping," selectively killing a portion of the wild herds in parks to prevent the animals from destroying their own environments. Those who favor this approach, called "Man's Way," point out that vegetation can be destroyed by excess animal populations in a very short time, particularly during periods of drought. Natural population control—through limits on food and water supply and through predation and fighting—may result in eventual return to equilibrium, but cropping proponents fear that damage from desertification may be irreversible by that time. They point too to the merits of supplying nearby human populations with meat from cropped animals, thereby reducing the opposition to human exclusion from wildlife preserves. Proponents of "Nature's Way," on the other hand, believe that it is always dangerous to

intervene in ecological cycles that balance out in the long run. They argue that cropping policies tend to become self-perpetuating, for animal populations compensate for herd losses by an increased birth rate.

Two contrasting approaches, with potential clues to their long-term effects, can be found in two national parks along the shores of Lake Idi Amin in Africa. Ruwenzori Park is in Uganda and Virunga Park is in Zaire. While cropping of hippopotami is practiced in the former, natural controls are allowed to work in the latter. It is too early to compare the results of these two approaches, but scientists are monitoring both areas to observe long-term results.[43]

The Wildlife Trade

International trade in wild animal products and, to a minor extent, in live wildlife also threatens the survival of some species. Most wildlife destined for the international market is captured in the less developed nations and imported into Europe, North America, and Japan. The United States, as the largest international consumer of wildlife and wildlife products, imported an estimated $1 billion worth in 1975.[44]

Wild animals are prized for their "wearables" (furs, hides, feathers, and scales), for their "edibles" (meats, eggs, and oils), and for specialty items (ivory, shells, claws, and stuffed specimens). Over the last century people's tastes for items as varied as whalebone corsets and alligator handbags have contributed to the depletion (and in some cases extinction) of a number of species.

Even where laws prohibit the taking of endangered, threatened, or other wild species, a great deal of illegal killing occurs. Indeed, it has proven impossible to control such killing within the animals' native habitats, even within protected reserves. A more effective means of preventing such abuses is by clamping down on the import market in developed countries, making it illegal for consuming nations to import species taken illegally elsewhere. The United States has prohibited the importation of illegally killed wildlife since 1900. We are also a signatory of the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora, which had been ratified by 46 nations by July 1978. The Convention outlaws international trade in over 350 endangered species. However, enforcement of the Convention and of the wildlife protection laws of individual nations is made extremely difficult by the widespread falsifying of records, the disguising of countries of origin through elaborate shipping routes, and other tactics practiced by those in the trade.[45] In early 1978 the government of Kenya moved to curb poaching by banning the trade of all game skins and trophies.

F. Wayne King, a wildlife expert affiliated with the Bronx Zoological Park, believes that market forces, not statutes, could be the most effective means of reducing the wildlife trade. As supplies dwindle, prices rise and labor costs for crafts involving wildlife products become prohibitive. This pattern can be seen in the history

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of alligator hides. Sometimes, as with alligators, these economic forces come into play too late to save the species from overexploitation. Often the disappearance of one species results in the development of a market for a substitute; the Mexican sea turtle became very popular as the alligator population declined, and now it is endangered.

For developing countries, wildlife trade offers a tempting source of foreign exchange. The UN Development Program, the Food and Agriculture Organization, and the Agency for International Development have in the past sponsored projects to encourage wildlife exploitation as a means of economic development.[46] King advocates preparing environmental impact statements to evaluate the consequences before funding such projects by AID. Recent changes in AID compliance with the National Environmental Policy Act suggest that such statements will be prepared in the future.

Although wildlife has received relatively little attention from the international aid community, its role in boosting tourism is increasingly recognized as worthy of support. In 1977, the World Bank provided $17 million to Kenya under its tourism development program. The funds are to be used to implement government conservation policies (including antipoaching measures), to finance a Wildlife and Fisheries Training Institute, and to increase the economic benefits of tourism in rural areas.

Wildlife issues cannot be separated from the larger problems confronting the developing world—issues of land use, human density, food supply, and economic development. A balance between the interests of people and animals is as important in its own way as the link between people and the other elements of our environment.

WATER RESOURCE DEVELOPMENT

Irrigation: The Dangers of Improper Use

Irrigation is a technology used by farmers since ancient times to coax dry lands to produce crops. Indeed, the potential increases in productivity offered by irrigation are enormous. According to the United Nations, yields of cereal grains have increased sixfold and root crops four- or fivefold in many irrigated regions. Approximately 250 million hectares (625 million acres)—13 percent of all cultivated lands—are irrigated.[47]

As long ago as the Sumerian and Babylonian civilizations, it became apparent that irrigation was not without danger. Unless special care is exercised, alterations in the level of water tables, rate of salt leaching, and flow of natural waterways can cause irrigated lands to turn into wastelands.

"Vast areas of southern Iraq [glistening] like fields of freshly fallen snow" are described by Erik Eckholm of the Worldwatch Institute. The scene is an irrigated region of the Euphrates River valley

The Serengeti National Park was established 40 years ago to protect the magnificent wild animals of east Africa. Conflict between the interests of the animals and people in the area is sometimes intense.

rendered useless by heavy deposits of salt left on the soil surface by inadequately drained water.[48]

Although few countries maintain statistics that indicate water consumption by economic sectors, a report of the 1977 UN Water Conference estimates that as much as 90 percent of the water used in developing nations goes to agricultural use.[49] Fields may be irrigated by constructing dams and networks of canals or by bringing

ground water to the surface through wells to feed distribution channels. In either case, supplying just the right amount requires a sophisticated knowledge of hydrology and soil characteristics. Too much water coupled with inadequate provision for drainage gradually raises the ground water table until it comes within a few feet of the surface. Then capillary action draws water upward to the surface, where it damages crop roots and evaporates, leaving behind a deposit of salts. The result is saturation or "water logging," often accompanied by a sharp increase in soil salinity. Too little water also impedes the natural leaching process, causing excess salinity. Together these phenomena affect somewhere between 30 and 80 percent of all irrigated land. The UN Environment Programme estimated that as much as 200,000 or 300,000 hectares (500,000–750,000 acres) must be abandoned each year because of waterlogging and excess salinity.[50]

Many countries experience losses at a far greater rate. After 60 years of irrigation in the Indus River valley of Pakistan, 90 percent of the lands involved were subject to waterlogging and 20 percent were seriously affected by salinity, with the worst areas recording saline concentrations as high as one part per hundred, ten times higher than preirrigation levels.[51] In India, 15 percent of all irrigated lands were seriously damaged by waterlogging and salinity problems by 1972, and in northeastern Brazil as much as one–half the irrigated acreage is believed to be affected to some extent.[52]

Remedies for Waterlogging and Excess Salinity

Remedies to these twin problems involve installing drain tiles or drilling tubewells to draw down the water table and return ground water to the land with a flow sufficient to leach out salts. To accomplish the further objective of improving agricultural productivity, these technical solutions must be coupled with sound land and water planning and management as well as with agricultural extension services to disseminate information about proper use of irrigation water, seed varieties, fertilizers, and cultivating techniques such as companion planting.

A number of national governments and international organizations have undertaken projects to rehabilitate damaged lands, with varying degrees of success. Two such efforts were included among the case studies prepared for the UN Conference on Desertification. The Pakistani government initiated the Salinity Control and Reclamation Project (SCARP) in the Jhelum River Valley in 1958, seeking to reverse the effects of a half–century of damage caused by unlined irrigation canals, unmaintained drainage ditches, inadequate leaching flow, and primitive farming methods used by a population with very low literacy rates. After 10 years' experience with tubewells, improved ditch drainage, and intense education efforts, the water table had dropped 1 or 2 meters, and the saline area had been reduced by about one-third.[53]

Rehabilitation efforts in Iraq were less successful. A $10 million

drainage project initiated by the Iraqi government in 1965 and supported by the Food and Agriculture Organization and the UN Development Program beginning in 1970 provided some decline in salinity. But agricultural productivity failed to improve significantly because farmers were not provided with information about better farming methods, because funds and personnel were not adequate for proper maintenance of the drainage facilities, and because the prevalent land tenure arrangements failed to provide farmers with motivation to improve the soil.[54] This case illustrates the need for integration of sound irrigation practices into the larger context of improved agricultural methods.

The Aswan Example

The Aswan High Dam in Egypt has caused what may be the world's most publicized side effects of water resource development. For centuries farmers in the Nile River valley have enjoyed the benefits of unusually fertile farmland enriched by annual flooding and the accompanying deposit of new topsoil from upstream. Regular flooding also leached away the salts on irrigated lands. Since the Dam's completion in 1968, downstream salinity has increased significantly (both from the lack of flushing by floodwaters and from saltwater instrusion from the Mediterranean), the Delta water table has risen to dangerous levels, coastal sardine fisheries have been affected, chemical fertilizer needs have grown because of lack of natural soil enrichment, crop yields have declined, and silt has collected in Lake Nasser, the Dam's enormous reservoir. Of course, the Dam has provided benefits as well—hydropower for the development of Egyptian industry, protection from extreme floods and droughts, expansion of agricultural lands through irrigation, the creation of a new fishery in Lake Nasser, and relief from the constant dredging required before the Dam was built.

Egyptian officials believe that these benefits outweigh the Dam's adverse environmental impacts.[55] But it is clear that correcting the problems will be a difficult and expensive undertaking. To prevent an expected 30 percent decline in Nile basin crop yields over the next few years, the World Bank has provided loans for tile drainage projects designed to flush away excess salts. The Bank's commitment seeks to correct problems on 3 million acres, about one-half of Egypt's irrigated land, at a total cost of $250 per acre (including Egypt's contribution).[56]

A Cautious Approach to New Irrigation Projects

In light of all these problems as well as the public health implications of water resource development, multinational aid organizations and national governments face a major challenge in rehabilitating lands currently in difficulty as a result of poorly devised or maintained irrigation programs. In an address to the 1977 UN Water Conference in Argentina, CEQ Chairman Charles Warren said: "Our analysis of crop yields, farming conditions and water utilization

around the world indicates that the overriding focus should not be on the amount of new land and water that might be developed for agriculture but rather on improving the effectiveness with which water and other production aids are applied and managed on land already under cultivation." He acknowledged the need for new irrigation projects in some countries but concluded that "because of the high cost of development and the danger of long-term environmental degradation, new irrigation projects should be planned carefully and thoroughly." [57]

WATER QUALITY AND HUMAN HEALTH

The intimate connection between environmental quality and human health is widely acknowledged; yet it remains very difficult to battle environmentally caused diseases. Waterborne diseases are a particular problem in the less developed nations; the challenge of dealing with them is increased by the fact that their remedies often include procedures or substances with adverse environmental effects of their own. Ironically, too, such diseases often spread in the wake of water resource development projects that are intended to provide important benefits, including the expansion of agricultural lands through irrigation to provide better nutrition for expanding populations.

Waterborne diseases include typhoid, cholera, malaria, amoebic dysentery, roundworm and hookworm, filariasis, trachoma, schistosomiasis, and onchocerciasis (river blindness). Some, like typhoid and cholera, are attributable to fecal contamination in water; others, like malaria and river blindness, come from insects such as the mosquito and the black fly. Dysentery is a leading cause of death for infants and children in the Third World.

Aswan's Other Impact

In creating the enormous Lake Nasser reservoir and a large network of irrigation canals, the engineers also provided a mammoth habitat for snails that are the critical link in the life cycle of a parasitic worm which causes schistosomiasis. The worm enters the human body by penetrating the skin and passes back out of its human host with bodily wastes. In the absence of good sanitation facilities, the worm then returns to the aquatic environment to perpetuate the cycle.

Schistosomiasis is not a new disease in Egypt—Napoleon noted its presence—but its incidence there has tripled since completion of the Dam, according to one estimate. Its symptoms include debilitating weakness and lethargy, pain, and bloody urine. It is rarely fatal; yet the misery it causes makes it a major public health concern. Egyptian productivity losses due to schistosomiasis are estimated at between $100 and $200 million annually.[58] Approximately 250 million people

in the world have schistosomiasis. It is a problem in less developed countries on every continent.

In 1959, before the Aswan Dam was built, the World Health Organization warned of the danger of increased schistosomiasis and recommended providing sanitary waste disposal systems and safe domestic water supplies along with the irrigation canals that would be fed by the waters of Lake Nasser.[59] Because WHO's recommendations were not carried out, most efforts to control the disease since the Dam's completion have relied on widespread and repeated spraying with molluscicides whose long-term impacts on the aquatic environment are little known. This approach is rarely completely successful because the host snails reproduce asexually and rapidly. A single surviving snail can produce a whole new snail colony in a matter of months. Experience with other pesticides suggests that resistance to the killing effects of these chemicals may increase over time. Scientists are also watching for adverse effects on other aquatic species.

Engineering approaches to schistosomiasis control include varying the level of lake waters, altering the velocity of canal waters, and physically removing snails and the water weeds on which they feed. Each of these tactics is difficult, expensive, and problematical. For example, altering the flow of irrigation channels can interfere with efficient use of the system and exacerbate waterlogging problems.

Drugs are also used to attack the parasitic worms infecting people. In St. Lucia, a Caribbean island, the Rockefeller Foundation has tried a three-pronged attack including mulluscicides, sanitary facilities, and medication; the combination has achieved a reduction in the incidence of schistosomiasis. A similarly integrated approach has brought results in China, where two-thirds of those infected in the early 1950's are now reported cured, and more than two-thirds of the affected geographical territory is now considered free of schistosomiasis.[60] Coordinated attacks on this disease are being made elsewhere by the World Bank, the UN Environment Programme, the World Health Organization, and the Agency for International Development.

The Losing Battle against Malaria

Malaria still strikes 100 million people annually, killing 1 million. A few years ago public health officials spoke about the imminent "eradication" of malaria; now with evidence of a resurgence of the disease in many areas, the operative word is "control." The situation in Pakistan is particularly shocking. When a massive antimalarial campaign began there in 1961, there were 7 million cases. By 1968, that number had dropped to 9,500 cases, and it seemed possible to reduce the incidence to 0 by 1975. In that year, however, there were 10 million cases reported, and the disease was increasing at a rate that could produce 23 million cases by 1979. Similar resurgences of malaria were reported in Thailand, India, Sri Lanka, Vietnam, Indonesia, and Bangladesh. This striking reversal appears to be

attributable to a number of factors, including inadequate funding and personnel for the control programs (particularly after the first few years), inadequate attention to urban areas, administrative problems, and—most alarming—a growing resistance to DDT among the disease-causing mosquitoes.[61]

River Blindness Control Efforts

An international effort to control onchocerciasis, river blindness, also illustrates many of the difficulties involved in battling diseases carried by waterborne insects. River blindness is most prevalent in west Africa and in tropical regions of South America. More than 20 million persons suffer from onchocerciasis worldwide, and it has been estimated that half the inhabitants of some parts of west Africa are infected, with 30 percent experiencing impaired vision and 20 percent permanent blindness as a result.[62] Black flies are the vectors of onchocerciasis; their larvae breed on stones and logs in fast-flowing streams. Fear of the disease causes social disruptions almost as tragic as the disease itself; some of west Africa's most fertile river basins have been virtually abandoned by populations fleeing to the crowded and relatively unproductive uplands.

Effective control through pesticide spraying requires coverage of entire river basins and nearby forests. In 1974, a massive spraying program began under the leadership of the World Health Organization, with west African national governments, the UN Development Program, and the World Bank also participating. The Program, which makes use of the larvacide temephos sprayed from airplanes, is expected to last 15–20 years and cost $6 million annually.[63]

New Approaches to Pest Management

A truly effective campaign against river blindness and other insect-borne diseases must include several techniques in addition to pesticide spraying. Robert L. Metcalf, a specialist in integrated pest management, recommends supplementing the chemicals used against river blindness with drug therapy for infected persons, black fly repellents by farmers and fishermen, river channel improvements to eliminate obstructions where larvae can breed, and biological controls with natural predators and parasites.[64]

Many agencies are trying innovative techniques in order to avoid the environmental dangers of overuse of chemical pesticides. Sterilization of insects to prevent breeding, use of natural substances such as dodecandra berries to eradicate snail populations, reliance on natural predators or species that compete with harmful disease vectors for food supplies—these concepts of integrated pest management deserve further experimentation in the ongoing campaign against disease caused by waterborne pests.

The Need for Water Supply and Sewage Disposal Systems

For many waterborne diseases, providing uncontaminated water is

Pest management specialists inspect larvae of the black fly which carries river blindness disease. Pesticide spraying alone has not been effective in the short term.

the key to prevention and control. Public health experts believe that universally available clean water supplies could reduce the incidence of cholera, for example, by 90 percent.[65] The World Health Organization reports that as of 1975, 1.2 billion people (almost two–thirds of the population of the developing countries) lacked access to clean water supplies, and 1.4 billion lived without even simple waste disposal systems. "As a result," a Worldwatch Institute report stated, "environmental pollution by untreated human waste exacts a disease and death toll that dwarfs the known toll of industrial pollutants." [66] Although the multilateral lending institutions have financed both water supply and sewage disposal systems, their projects have been heavily skewed toward the former at the expense of the latter.

High cost is the major reason for the failure to provide safe, clean water. Water delivery systems can range in cost from $1 per person for simple shallow wells to as much as $50 per person for piped distribution, according to the World Bank. These figures do not include the filtration and chlorination that are usually necessary to ensure that the systems themselves do not become major conduits for disease. Waste treatment systems cost as little as $1 for a pit

latrine or as much as $200 per person for a sewage disposal and treatment system. The World Health Organization has proposed the worldwide expenditure of $35 billion over a 5–7 year period just to expand adequate water and waste facilities by 31 percent and 28 percent, respectively, by 1980.[67] A more ambitious goal—to provide "clean water for all by 1990"—was agreed upon at the 1976 UN Conference on Human Settlements and reaffirmed by the 1977 UN Water Conference.[68] Realizing this goal may cost as much as $125 billion.[69]

Impacts of Water Supply Projects

Even improved water supply and sewage disposal projects can have unforeseen adverse effects on the environment and on human cultures. Piped water has been known to accelerate the spread of disease, as in the Ryukyu Islands, where the installation of a new U.S.–funded water system following World War II led to an extensive outbreak of dysentery.[70]

The installation of piped water in the home also tends to induce a quantum leap in per capita water consumption, so that a system designed to serve a particular urban center may become inadequate almost immediately as need and population grow. Sanitary facilities must be accompanied by education and training for maintenance and use. Their design should be sensitive to long–standing social customs so that local traditions of drawing water, doing laundry, and other water–using tasks can be adjusted without social disruption or wholesale resistance. International aid programs for public health are showing increased emphasis on the advance evaluation of environmental effects of water supply and waste disposal projects.

PROBLEMS OF THIRD WORLD INDUSTRIALIZATION AND URBANIZATION

Urban Population Pressures

Throughout the developing world, nations are experiencing faster growth in urban populations and urban labor forces than in total numbers of people and workers. Massive migrations to towns and cities accelerate as rural populations increase, rural employment fails to keep pace, and urban industrial jobs pay better wages. In the poorest nations—those with per capita gross national products lower than $100—populations generally grew at an average annual rate of 2.3 percent in 1970, while urban population grew at 4.4 percent annually. Countries with slightly higher levels of prosperity experienced an urban growth rate of 5.4 percent per year, twice as high as their overall population growth levels.[71]

Without major new job–producing efforts, neither the cities nor the small villages and towns will be able to absorb the increases in the labor force that are certain to occur in Third World countries between now and 2000. Experts disagree about where the greatest

efforts should be made. In its 1976 Annual Report, the World Bank said: "If there is to be any improvement in the lot of the poor, rural and urban, the towns and cities must, in the future, absorb and employ most of the increase in the labor force." [72] Yet others believe that agriculture and village economies can provide more jobs than urban industries through labor–intensive small–scale farming, public works, light industry, and marketing functions. In a study of energy and agriculture in the developing countries, Arjun Makhijani pointed out that fertilizer and electricity for irrigation systems can be produced in two ways—in centralized large–scale capital–intensive plants or in village–scale operations using animal dung and crop residues. Although the first approach could provide one job for every $20,000 of capital invested, the alternative would put one person to work for each $3,000 invested.[73]

Large–Scale Industrial Development

Makhijani and others believe that development programs have been slanted excessively toward large–scale industrialization.[74] The lending record of international aid organizations in fact shows a predominance of heavy industrial development projects, concentrating on iron and steel making, fertilizer and chemical manufacture, copper and phosphate mining and smelting, and pulp and paper production. The World Bank's industrial lending program—involving over $700 million in 1977—concentrates almost entirely on these heavy industries.

The large fertilizer industry has grown in response to the need to feed burgeoning populations within the poor countries, but many heavy industries produce for export to richer nations. Industrial development is viewed by national governments as an important source of foreign exchange and domestic employment.

Unfortunately, primary metals, chemicals, and paper products are energy–intensive and capital–intensive industries that provide relatively few jobs per unit value of output. Further, all these industries produce large quantities of air and water pollutants. Although a lack of monitoring systems in most industrial cities of the Third World prevents accurate assessment, many of these cities clearly suffer from severe pollution. A number of Latin American cities which do have pollution monitoring stations have recorded levels of sulfur oxides, particulates, carbon monoxide, and nitrous oxides that sometimes exceed recorded levels in U.S. cities notorious for their air, including Los Angeles.[75]

Such cities include Sao Paulo, Buenos Aires, Mexico City, Rio de Janeiro, and Havana. Sao Paulo is a good example of a city in trouble from industrial pollution. The largest and most industrialized Brazilian city, Sao Paulo has a current population of 10 million and is expected to grow to 26 million by 1985. The Brazilian government, with help from the World Bank, is just beginning to devise control strategies, including a policy of discouraging new polluting factories from locating in Sao Paulo.

Industry is not the only source of pollution. Sao Paulo and other densely populated cities face another dilemma familiar to urban centers throughout the developed world—the difficulty of automobile pollution. Other sources of poor air quality include the city's closely packed residences where firewood, kerosene, or coal is burned for cooking and heating. Water pollution comes from inadequate or even nonexistent sewage disposal systems as well as from industrial effluents.

Several national governments and international agencies are beginning to address the pollution problems of industries in developing countries. The World Bank has included funds for pollution control in several industrial development and modernization loans; they include aid to a cement plant in Colombia, a copper smelter in Botswana, several fertilizer plants in India, and the copper mining industry in Peru.[76] The UN Environment Programme has provided technical assistance in pollution control to a west African nation constructing a new sugar mill. The U.S. Environmental Protection Agency responds to many requests each year for technical assistance in such projects as pollution monitoring systems, waste water treatment plants, and pollution control legislation; EPA's help is offered on a reimbursable basis, which tends to limit its availability to nations on the upper rungs of the developing world's economic ladder except where AID pays the costs of EPA assistance.

The Need for Labor–Intensive Development

No realistic level of large–scale industrial development could keep pace with the growing urban populations and work forces of the less developed countries. "There is substantial evidence indicating that modern large–scale enterprise will not provide employment opportunities for more than a fraction of the growing labor force," the World Bank noted in its 1976 Annual Report.[77] In the cities, increased emphasis should be placed on labor–intensive activities which also tend to carry lower polluting potential and to hold promise of meeting many of the basic human needs now lacking in many parts of the Third World. Such activities could include small–scale industries, transportation, housing construction, and services like education and health care. In the countryside, well-planned agricultural development—including irrigation projects, improved plant varieties and pest management, environmentally desirable energy systems to provide for the urgent needs both in the fields and in village homes—could increase the number of productive, decently paid rural jobs and relieve the pressure of immigration to the cities.

Providing Basic Needs

In 1975, 190 million urban dwellers lacked access to basic amenities such as decent housing, clean water, sanitation, and medical care although 40 million of this number were theoretically able to afford these things.[78] That these people were unable to meet their

needs is due to the failure of service delivery systems in the cities of poor countries.

One–half the people doing without basic needs in 1975 lived in south Asia, while another one–quarter were Latin Americans. Their numbers continue to grow at the estimated rate of 11 million per year.[79] They live in squalid, overcrowded squatter shacks or slum tenements in cities like Bombay, Jakarta, Mexico City, Karachi, and Manila—cities whose populations will exceed those of New York, Tokyo, and other industrialized centers by 1990. At current growth rates, these Third World cities will double their inhabitants in less than 20 years, some in less than a decade. Given these figures, the probability of providing decent housing for all incoming migrants is virtually nil, not to mention the even more remote possibility of improving the overall urban housing stock. Past and present housing programs sponsored by organizations have met only a tiny fraction of the need.

A Self–Help Approach to Urban Needs

Recently the World Bank and other organizations have shifted their emphasis to a concept called "sites and services" in the hope of stretching aid dollars over a larger portion of the needy urban population. Sites and services projects leave housing construction to the poor who settle in the cities and who build in the traditional way—through "self–help," with available materials and funds, however meager. The Bank and the governments of countries and cities that share costs for sites and services projects aim to make new settlements better than the usual squatter slums by providing land that is graded and provided with drainage, water supply, sewage treatment, electric service, and access roads. Sometimes additional services like public health clinics, schools, recreation centers, and police protection are also included. In a few instances the Bank's funds have provided low interest construction loans for settlers as well as technical assistance with building construction. An effort is made to ensure that the sites are located near employment opportunities and marketplaces.

This approach too is imperfect. The cost–sharing arrangement that underlies it—requiring settlers to pay for their buildings and a portion of the costs of land and services—means that the very poorest are excluded. Rapidly increasing land values, reflecting the cities' growing population pressures and the speculation which invariably crops up in land shortage situations, threatens to make such projects prohibitively expensive. Hopes that the sites and services concept would make headway against disease by providing clean water and waste treatment have been only partially realized; the new systems often become inadequate almost immediately, as the demand for water, encouraged by the systems themselves, increases sharply and exceeds the available supply. Further, sites and services projects have lacked a means of allowing target populations to participate in planning their own neighborhoods, with the result

that the services provided have not always matched residents' needs or pocketbooks.

Population: The Bottom Line

Urban problems in the developing world have their roots in the population explosion that strains Third World resources.[80] Solutions must include continued efforts to control population growth as well as agricultural development, land use and resource management programs, and industrial development policies that will permit wider distribution of both industry and settlements. Spreading people, jobs, resource needs, and environmental side effects over wider areas in manageably sized communities probably offers the best hope of reducing urban and industrial pollution and providing the basic requirements of the greatest number of people.

CONCLUSION

The economists who met at Founex, Switzerland, in 1971 concluded that "concern for environment must not and need not detract from the commitment of the world community—developing and more industrialized nations alike—to the overriding task of development of the developing regions of the world." [81] On the contrary, they and others who have addressed the issues of environment and development in recent years have recognized that the development process itself can offer permanent improvement in the lot of the world's poorer people only if it includes a sensitive approach to the natural systems on which these people must rely for survival.

In 1978, there are grounds for encouragement about the growing trend to include environmental planning in development projects. The first 5 years' experience with the UN Environment Programme has demonstrated the beginnings of a multinational commitment to environmental values. The World Bank has developed environmental review procedures for its pending projects through its Office of Environmental and Health Affairs. Although this office is small and recent evaluations suggest a need to bring it into project planning at an earlier point, its record to date includes a number of project design changes to include environmental mitigation measures.

Other multilateral development banks and institutions are less advanced in assessing the environmental aspects of development projects. A new study of nine multilateral agencies* by the International Institute for Environment and Development pointed to

* The agencies are the African Development Bank, the Arab Development Bank, the Asian Development Bank, the Caribbean Development Bank, the European Development Fund, the Inter–American Development Bank, the World Bank, the Organization of American States, and the UN Development Program.

four major areas in which improvements are needed.[82] First, except for the World Bank, the agencies lack procedures for environmental assessment of their lending programs. Second, they have not established criteria for judging the impacts of various kinds of projects. Third, they lack analytical tools for measuring environmental improvement comparable to the discount rate, for example, as a tool for judging economic benefits. Last, again excepting the World Bank, agencies lack officials who are trained and competent in environmental assessment.

In the United States, the inclusion of environmental concerns in foreign aid ventures has emerged from several sources. AID, in response to a lawsuit brought by four environmental organizations, agreed in 1976 to subject its activities to assessment under NEPA and has established an Environmental Coordinator. The International Development and Food Assistance Act of 1977 has added "environment and natural resources" to the functional categories for which development aid may be given; AID is now providing assistance for several such projects, including renewable resource management projects in Nepal and Haiti. President Carter, in his March 1977 Environmental Message to Congress, directed the Agency for International Development, the State Department, and other relevant agencies to consider fully the environmental soundness of their aid programs and to provide training to environmental and resource management professionals in the developing countries.

The United States and other developed nations and organizations cannot and should not impose a particular set of values—environmental or otherwise—on the emerging nations of the world. Their responsibilities lie rather in providing adequate information to these nations so that they may make their own choices regarding the possibilities of environmentally sound technologies and the level of environmental protection that they can afford at the time.

In many cases, informing nations which receive aid about the environmental implications of proposed actions also means making better information available to the aid-giving organizations themselves. More knowledge in turn makes it more likely that development projects will in fact help out with the environmental problems caused by the lack of development while avoiding the exacerbation of such problems—or the creation of new ones—as part of the development process itself.

The resources available to aid-giving nations and organizations for the benefit of the Third World are not limitless. The greatest progress toward environmentally sound development will come from a partnership between the developing nations and the agencies who assist them, relying on a firm commitment by the recipient nations to the ideal of progress based on respect for the natural systems that must support economic and social well-being.

NOTES ON RECENT EVENTS

WORLD POPULATION

The National Security Council Ad Hoc Group on Population Policy, composed of representatives of 18 federal departments and agencies, reports evidence that birth rates are beginning to decline slightly in an increasing number of developing countries, in some cases overtaking declines in death rates. The decline is 0.1 percent from the high of 2.6 percent in the early 1970's to 2.5 percent in 1976.

Ten of the 13 countries accounting for four-fifths of the population of developing nations* have adopted population policies and programs to reduce fertility in the interest of national development as well as family health and welfare. Some of these programs, such as in China, Indonesia, and Thailand, have made considerable progress, but others in India, Bangladesh, and Pakistan, for example, face significant political and institutional constraints, and the development of programs in African countries continues to be slow.[83] Thus, although it is encouraging to see developing countries' average rate of population growth begin to decline, it must be recognized that population expansion remains much too high in too many developing states.

There is increasing international attention to controlling population growth in the form of larger amounts of donor assistance from governments and international organizations (especially the UN Fund for Population Activities and the World Bank) as well as from private organizations, including the International Planned Parenthood Federation. In the past year, the Department of State and AID have jointly worked to improve U.S. population assistance programs by laying out longer–term strategies in a number of countries (for example, Bangladesh, Pakistan, and Morocco) and developing comprehensive performance criteria. Included among the criteria are the financial contributions of the countries receiving assistance and the prevalance of contraceptive use in these countries. In addition, AID supported low–cost community–based delivery systems in its programs abroad.

OIL POLLUTION

U.S. proposals to reduce both accidental and operational oil pollution from tankers were considered at the International Conference on Tanker Safety and Pollution Prevention held in London in February 1978 under the auspices of the InterGovernmental Maritime Consultative Organization. The Conference adopted many

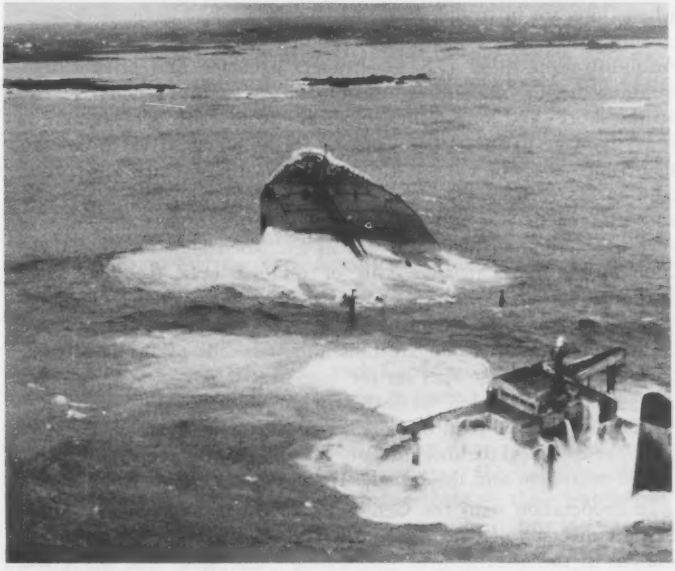
* The 10 are China, India, Indonesia, Bangladesh, Pakistan, Mexico, Vietnam, the Philippines, Thailand, and Egypt. The three without population policies and programs are Brazil, Nigeria, and Turkey.

of the initiatives proposed by President Carter for improved construction and equipment of oil tankers but compromised on others. Stronger inspection and certification requirements were also adopted, and target dates were set for entry into force of the conventions and protocols—June 1979 for the safety requirements and June 1981 for the pollution requirements, with a recommendation that the new standards be implemented before these dates (see Chapter 8, Energy, for further discussion of the new tanker requirements).

The important issue of training and qualification of tanker officers and crews was taken up at another IMCO–sponsored conference in June and July 1978.

Since the February conference, the worst oil spill in maritime history occurred in the English Channel. On March 17, the oil tanker *Amoco Cadiz* went aground 2 kilometers off Portsall on the Brittany coast of France.

Efforts to stop the spill or contain it were unsuccessful. The ship broke apart and high winds and seas made it impossible to transfer oil to other tankers, with the result that the entire cargo of 216,000 tons of crude oil was spilled, polluting the waters and shoreline along 200 kilometers (124 miles) of the coast and 60 kilometers (37½ miles) out to sea. The booms placed across harbors and estuaries were not effective in keeping the flood of oil out when winds and tides rose.



The wreck of the *Amoco Cadiz* resulted in the worst oil spill in history. Stormy weather hindered rescue efforts and spread the oil along 200 kilometers of the French coast.

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Nearly every conceivable cleanup technique was used—trenching the beaches with road graders and pooling oil to be collected by hand shovels and scrapers, filling honeywagons (small pig manure tanks from local farms) by means of suction hoses, and scooping "mousse" (oil–water emulsion) from the water surface with buckets. Laborious hand work was the most effective. Three weeks after the spill, it was estimated that at least 50,000 tons of oil had come ashore, of which no more than 5,000 had been removed.[84]

Oil released from bottom sediments continued to come ashore in the weeks following, and at the end of May, 8,000 workers (mostly soldiers) were still struggling to collect it and keep it off beaches that had already been cleaned. The economy of the region, based as it is on tourism and fishing, suffered severely. The dollar cost of the damage had not yet been estimated, but cleanup costs alone were expected to exceed $50 million.

France is now requiring passing tankers to remain more than 7 miles offshore and has proposed several reforms for study by the InterGovernmental Maritime Consultative Organization, including new tanker routes off north European shores, reexamination of the steering gear requirements just adopted by IMCO at the February tanker conference, better enforcement against substandard ships, and a possible requirement for duplicate propulsion, steering, and electric generating systems. In addition, France asked for review of the international treaty covering compensation of oil damages and of the 1910 convention which still governs assistance and salvage when ships are in trouble.[85]

Shortly after the oil spill, the National Oceanic and Atmospheric Administration, other U.S. government agencies, and private organizations began cooperative research efforts with French scientists on the short– and long–term ecological effects. Early reports were of heavy damage to animals and plants. In the marsh at Ile le Grande, there were pools of mousse 15 centimeters thick, crabs and nereid polychaete worms were dead, grasses were completely blackened, and the marsh was not expected to recover unless the oil was drained.[86] An intertidal sand flat at St. Michel–en–Greve showed "one of the most massive kills of infauna ever recorded"; the 2–kilometer stretch of sand flat was "littered with millions of shells," mostly heart urchins and razor clams.[87]

Preliminary results indicate that although it is preferable to disperse oil from a large spill on the high seas if possible, contingency plans must be prepared to deal with oil on the shore when there is a large spill with high onshore winds and heavy seas. The longer the cleanup takes, the more deeply the spilled oil will penetrate the coastal ecosystem and the broader its impacts are likely to be.

In cooperation with the Center for Ocean Management Studies at the University of Rhode Island, NOAA will conduct an economic analysis of the aftermath of the *Amoco Cadiz* spill. The study will assess damage to market and nonmarket goods such as fishing, property values, recreation, and human health.

ANTARCTIC FISHERY

A Special Meeting of the Consultative Parties to the Antarctic Treaty was held in Canberra, Australia, February 27–March 16, 1978, to work out a regime for the conservation of Antarctic living marine resources and to arrange for subsequent conferences to adopt the regime.[88] Eight of the Consultative Governments, including the United States, introduced draft conventions for regulating the harvesting of the Antarctic fishery, beginning with krill[89] (see also Chapter 7, Ecology and Living Resources). There was a consensus that the composite draft convention should be open to all states with an interest in research or harvesting within the convention area. However, several important issues remained to be resolved at a second Special Consultative Session to be held in Buenos Aires, Argentina, in July 1978. They include interim and permanent conservation standards and measures, voting procedures, protection of claimants' and nonclaimants' positions regarding coastal state jurisdiction, and the observer–inspection mechanism. Antarctica offers the nations of the world the unique opportunity to design a sound conservation system based on an ecosystem approach before the resources involved are overexploited.

LAW OF THE SEA

The Seventh Session of the Law of the Sea negotiations took place in Geneva March 28–May 19, 1978. Despite delays and disputes among the participating nations on many issues, the U.S. Delegation characterized this session as one of the most intensive periods of simultaneous negotiation in the history of the Third UN Conference on the Law of the Sea.[90] However, it remained to be seen whether the sharply differing views in many areas, including a deep sea mining system, continental shelf jurisdiction, settlement of disputes, and marine science research, could be reconciled in a follow–on session in New York August 21–September 15, 1978.

The Seventh Session produced significant improvements in the informal negotiating text on the prevention, reduction, and control of pollution from ships. These improvements resulted from efforts by the United States, France, and Canada. The new texts on marine pollution expand nations' duties to protect endangered species and fragile ecosystems from pollution, expand the duty to comply with ship routing systems and requirements that ships give notice of pollution hazards, clarify how the pollutant discharge standards of coastal nations apply to vessels passing through their waters but not headed to their ports ("innocent passage"), provide that a coastal nation may arrest a ship in its economic zone when there is clear, objective evidence of a pollution discharge causing major damage or threat of damage, and propose that states attempt to harmonize port entry requirements.[91]

REGIONAL SEAS PLAN

The Convention for the Protection of the Mediterranean Sea against Pollution entered into force in February 1978, 2 years after its signature at Barcelona. The Convention commits the parties to "take all appropriate measures . . . to prevent, abate and combat pollution of the Mediterranean Sea area and to protect and enhance the marine environment of that area." Two protocols to the Convention, one on ocean dumping (closely following the provisions of the 1972 London and Oslo Conventions) and the other on cooperation (through information exchange, coordination of communications, and assistance in emergencies) in dealing with spills of oil and other harmful substances, entered into force with the Convention. A third protocol on problems of land-source pollution is under development. This protocol is more difficult for the Mediterranean nations to agree upon because of the economic implications of measures to reduce discharges of pollutants from factories, cities, and tourist resorts.

In April 1978 the United Nations Environment Programme held a conference in Kuwait; eight countries in the area agreed to protect their common marine environment and set up a $6.3 million trust fund to further their purpose.

UNEP is also encouraging the development of other regional seas plans in the Caribbean, Gulf of Guinea, east Asian waters, the Red Sea, and the Southeast Pacific. These plans are in varying early stages of formulation.

TRANSBOUNDARY AIR POLLUTION

International efforts to deal with long-range transport of pollutants through the atmosphere continued on both the political and scientific fronts. "Acid rain," attributed to sulfur and nitrogen pollutants from distant industrial and agricultural operations, commanded much of the attention, but scientific investigations were widened to detect other potential pollutants and their impacts.[92]

In August 1977, the UN Economic Commission for Europe convened the initial meeting of a Steering Body for Monitoring and Evaluating Long-Range Transport of Air Pollutants. The Steering Body adopted a work program for air pollution monitoring, beginning with sulfur dioxide, and selected several laboratories in east and west Europe to carry out chemical and meterological analyses of the air samples.[93] This ECE program is a European contribution to UNEP's Global Environmental Monitoring System.

The United States and Canada are developing a program for cooperative monitoring and research on the cause and effects of increasing acid precipitation in both countries.

ENERGY

The environment and energy units of the UN system and those of such regional bodies as the Organization for Economic Cooperation and Development are just beginning to interact. Aside from some expert studies undertaken by UNEP and the Environment Committee of OECD, efforts have been confined to the nuclear energy field. The International Atomic Energy Agency is working on improvement of the internationally agreed–upon definition of high level nuclear wastes and on conforming the procedures for disposal of lower level wastes to the provisions of the 1972 Ocean Dumping Convention.[94] The International Nuclear Fuel Cycle Evaluation effort, resulting from a U.S. Presidential proposal in April 1977, is a 2–year technical and analytical study of the complete nuclear fuel cycle by more than 55 countries to identify how best to minimize the risks of proliferation while making available the benefits of nuclear energy (see Chapter 8, Energy, for further discussion). The Environment Committee of OECD is providing assistance to the Nuclear Energy Agency, also a part of OECD, in its responsibility for supervising ocean dumping of low level radioactive wastes by member countries.

MANAGEMENT OF NATURAL RESOURCES

Three trends are noticeable as countries, individually and collectively, attempt to cope with diminishing productive capacity of their natural resource bases. There is a growing recognition of the need for integrated management of resources—that is, a weighing of the economic, social, and environmental consequences of alternative uses of resources. International programs for integrated resource management include UNESCO's Integrated Program for Arid Lands, the Food and Agriculture Organization program on Ecological Management of Arid and Semi–Arid Rangelands, UNESCO's Man and Biosphere program, which includes 500 ecosystem management projects in 85 nations, and the United Nations University's selection of natural resources management as a major area of research and study.[95] All these efforts are supported by the United States.

There is also increasing attention to management of natural resources shared by two or more nations. Both the International Law Commission and UNEP are developing principles for international cooperation in the development and use of such resources as oil and gas and water. Conflicts over surface waters have been common. Equitable allocation of underground water is an emerging problem. A new UN–sponsored project on the Management of Major Regional Aquifers in North East Africa and the Arabian Peninsula reflects the increasing interest in this problem.

Third, there is a trend toward greater interest in using innovative science and technology for natural resource management. Developing

nations in particular are stressing a desire to build their own scientific capabilities for resource assessment, planning, and development. In addition, the use of satellite–based remote sensing to inventory and monitor resources is attracting special attention. Other areas of interest include new approaches to forest and rangeland management, establishment of biosphere reserves for study purposes, and research and development on energy– and resource–saving techniques for food production and industry.

MAJOR WORLD CONFERENCES

Three important United Nations–sponsored conferences were held in 1977, one on environmental education in addition to those on water and desertification noted earlier.

As a result of the UN Water Conference, 1980–90 was designated the International Drinking Water Supply and Sanitation Decade. Developing countries are preparing national community water supply and waste disposal assessments and plans with the assistance of the World Health Organization and the World Bank. The United States has indicated a special interest in responding to requests for development assistance, and AID and Peace Corps Missions have been requested to include opportunities for such projects in their planning. A U.S. statement of progress and intentions for the Drinking Water Decade is under preparation for presentation to the United Nations.

The UN General Assembly, in its resolution of December 1977 on the results of the Conference on Desertification, recommended that subregional cooperation be initiated or intensified among countries affected by desertification. Northern Mexico and the U.S. Southwest have similar arid lands problems and a history of cooperation in dealing with them. The two countries consulted with each other before and during the Desertification Conference. The Mexican government is developing a National Plan for Desertification, and further discussions with the United States are expected in late 1978 or in 1979. A U.S. government interagency group is considering priorities among programs that range from joint development of comprehensive management, monitoring, and data exchange systems to improving the productivity of rangelands.

The October 1977 Intergovernmental Conference on Environmental Education in Tbilisi, USSR, reached agreement on 41 recommendations on the role, national strategies, and international cooperation for environmental education.[96] The Subcommittee on Environmental Education of the Federal Interagency Committee on Education published a Conference report which has been widely disseminated to environmental education groups and individuals in the United States.[97] A National Leadership Conference for Environmental Education met in Washington, D.C., March 28–30, 1978, to consider means of improving coordination of public and private efforts to develop environmental education in the United States.

This conference, organized by the Alliance for Environmental Education and representing 33 nongovernment organizations, recommended setting up a National Center for Environmental Education. It also proposed establishment of state offices of environmental education.

THE GLOBAL 2000 STUDY

In his May 1977 Environmental Message to Congress, the President asked for a study of the probable changes in the world's population, natural resources, and environment through the end of the century. The study is a first effort by federal agencies to achieve integrated long–term projections and analysis on a global scale and will provide the basis for strengthening the government's ability to perform long–term analysis and planning. The 2–volume report is scheduled for publication in 1979.

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APPENDIX A

THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969, AS AMENDED*

An Act to establish a national policy for the environment, to provide for the establishment of a Council on Environmental Quality, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "National Environmental Policy Act of 1969."

PURPOSE

SEC. 2. The purposes of this Act are: To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality.

TITLE I

DECLARATION OF NATIONAL ENVIRONMENTAL POLICY

SEC. 101. (a) The Congress, recognizing the profound impact of man's activity on the interrelations of all components of the natural environment, particularly the profound influences of population growth, high-density urbanization, industrial expansion, resource exploitation, and new and expanding technological advances and recognizing further the critical importance of restoring and maintaining environmental quality to the overall welfare and development of man, declares that it is the continuing policy of the Federal Government, in cooperation with State and local governments, and other concerned public and private organizations, to use all practicable means and measures, including financial and technical assistance, in a manner calculated to foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans.

(b) In order to carry out the policy set forth in this Act, it is the continuing responsibility of the Federal Government to use all practicable means,

*Pub. L. 91–190, 42 U.S.C. 4321–4347, January 1, 1970, as amended by Pub. L. 94–52, July 3, 1975, and Pub. L. 94–83, August 9, 1975.

consistent with other essential considerations of national policy, to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may—

(1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

(2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings;

(3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences;

(4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice;

(5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and

(6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

(c) The Congress recognizes that each person should enjoy a healthful environment and that each person has a responsibility to contribute to the preservation and enhancement of the environment.

SEC. 102. The Congress authorizes and directs that, to the fullest extent possible: (1) the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act, and (2) all agencies of the Federal Government shall—

(a) Utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment;

(b) Identify and develop methods and procedures, in consultation with the Council on Environmental Quality established by title II of this Act, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations;

(c) Include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on—

(i) The environmental impact of the proposed action,

(ii) Any adverse environmental effects which cannot be avoided should the proposal be implemented,

(iii) Alternatives to the proposed action,

(iv) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and

(v) Any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented.

Prior to making any detailed statement, the responsible Federal official shall consult with and obtain the comments of any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved. Copies of such statement and the comments and views of the appropriate Federal, State, and local agencies, which are authorized to develop and enforce environmental standards, shall be

made available to the President, the Council on Environmental Quality and to the public as provided by section 552 of title 5, United States Code, and shall accompany the proposal through the existing agency review processes;

(d) Any detailed statement required under subparagraph (c) after January 1, 1970, for any major Federal action funded under a program of grants to States shall not be deemed to be legally insufficient solely by reason of having been prepared by a State agency or official, if:

(i) the State agency or official has statewide jurisdiction and has the responsibility for such action,

(ii) the responsible Federal official furnishes guidance and participates in such preparation,

(iii) the responsible Federal official independently evaluates such statement prior to its approval and adoption, and

(iv) after January 1, 1976, the responsible Federal official provides early notification to, and solicits the views of, any other State or any Federal land management entity of any action or any alternative thereto which may have significant impacts upon such State or affected Federal land management entity and, if there is any disagreement on such impacts, prepares a written assessment of such impacts and views for incorporation into such detailed statement.

The procedures in this subparagraph shall not relieve the Federal official of his responsibilities for the scope, objectivity, and content of the entire statement or of any other responsibility under this Act; and further, this subparagraph does not affect the legal sufficiency of statements prepared by State agencies with less than statewide jurisdiction.

(e) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources;

(f) Recognize the worldwide and long-range character of environmental problems and, where consistent with the foreign policy of the United States, lend appropriate support to initiatives, resolutions, and programs designed to maximize international cooperation in anticipating and preventing a decline in the quality of mankind's world environment;

(g) Make available to States, counties, municipalities, institutions, and individuals, advice and information useful in restoring, maintaining, and enhancing the quality of the environment;

(h) Initiate and utilize ecological information in the planning and development of resource-oriented projects; and

(i) Assist the Council on Environmental Quality established by title II of this Act.

SEC. 103. All agencies of the Federal Government shall review their present statutory authority, administrative regulations, and current policies and procedures for the purpose of determining whether there are any deficiencies or inconsistencies therein which prohibit full compliance with the purposes and provisions of this Act and shall propose to the President not later than July 1, 1971, such measures as may be necessary to bring their authority and policies into conformity with the intent, purposes, and procedures set forth in this Act.

SEC. 104. Nothing in section 102 or 103 shall in any way affect the specific statutory obligations of any Federal agency (1) to comply with criteria or standards of environmental quality, (2) to coordinate or consult with any other Federal or State agency, or (3) to act, or refrain from acting contingent upon the recommendations or certification of any other Federal or State agency.

SEC. 105. The policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies.

TITLE II

COUNCIL ON ENVIRONMENTAL QUALITY

SEC. 201. The President shall transmit to the Congress annually beginning July 1, 1970, an Environmental Quality Report (hereinafter referred to as the "report") which shall set forth (1) the status and condition of the major natural, manmade, or altered environmental classes of the Nation, including, but not limited to, the air, the aquatic, including marine, estuarine, and fresh water, and the terrestrial environment, including, but not limited to, the forest, dryland, wetland, range, urban, suburban and rural environment; (2) current and foreseeable trends in the quality, management and utilization of such environments and the effects of those trends on the social, economic, and other requirements of the Nation; (3) the adequacy of available natural resources for fulfilling human and economic requirements of the Nation in the light of expected population pressures; (4) a review of the programs and activities (including regulatory activities) of the Federal Government, the State and local governments, and nongovernmental entities or individuals with particular reference to their effect on the environment and on the conservation, development and utilization of natural resources; and (5) a program for remedying the deficiencies of existing programs and activities, together with recommendations for legislation.

SEC. 202. There is created in the Executive Office of the President a Council on Environmental Quality (hereinafter referred to as the "Council"). The Council shall be composed of three members who shall be appointed by the President to serve at his pleasure, by and with the advice and consent of the Senate. The President shall designate one of the members of the Council to serve as Chairman. Each member shall be a person who, as a result of his training, experience, and attainments, is exceptionally well qualified to analyze and interpret environmental trends and information of all kinds; to appraise programs and activities of the Federal Government in the light of the policy set forth in title I of this Act; to be conscious of and responsive to the scientific, economic, social, esthetic, and cultural needs and interests of the Nation; and to formulate and recommend national policies to promote the improvement of the quality of the environment.

SEC. 203. The Council may employ such officers and employees as may be necessary to carry out its functions under this Act. In addition, the Council may employ and fix the compensation of such experts and consultants as may be necessary for the carrying out of its functions under this Act, in accordance with section 3109 of title 5, United States Code (but without regard to the last sentence thereof).

SEC. 204. It shall be the duty and function of the Council—

(1) to assist and advise the President in the preparation of the Environmental Quality Report required by section 201 of this title;

(2) to gather timely and authoritative information concerning the conditions and trends in the quality of the environment both current and prospective, to analyze and interpret such information for the purpose of determining whether such conditions and trends are interfering, or are likely to interfere, with the achievement of the policy set forth in title I of this Act, and to compile and submit to the President studies relating to such conditions and trends;

(3) to review and appraise the various programs and activities of the Federal Government in the light of the policy set forth in title I of this Act for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto;

(4) to develop and recommend to the President national policies to foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and

goals of the Nation;

(5) to conduct investigations, studies, surveys, research, and analyses relating to ecological systems and environmental quality;

(6) to document and define changes in the natural environment, including the plant and animal systems, and to accumulate necessary data and other information for a continuing analysis of these changes or trends and an interpretation of their underlying causes;

(7) to report at least once each year to the President on the state and condition of the environment; and

(8) to make and furnish such studies, reports thereon, and recommendations with respect to matters of policy and legislation as the President may request.

SEC. 205. In exercising its powers, functions, and duties under this Act, the Council shall—

(1) Consult with the Citizens' Advisory Committee on Environmental Quality established by Executive Order No. 11472, dated May 29, 1969, and with such representatives of science, industry, agriculture, labor, conservation organizations, State and local governments and other groups, as it deems advisable; and

(2) Utilize, to the fullest extent possible, the services, facilities and information (including statistical information) of public and private agencies and organizations, and individuals, in order that duplication of effort and expense may be avoided, thus assuring that the Council's activities will not unnecessarily overlap or conflict with similar activities authorized by law and performed by established agencies.

SEC. 206. Members of the Council shall serve full time and the Chairman of the Council shall be compensated at the rate provided for Level II of the Executive Schedule Pay Rates (5 U.S.C. 5313). The other members of the Council shall be compensated at the rate provided for Level IV of the Executive Schedule Pay Rates (5 U.S.C. 5315).

SEC. 207. The Council may accept reimbursements from any private nonprofit organization or from any department, agency, or instrumentality of the Federal Government, any State, or local government, for the reasonable travel expenses incurred by an officer or employee of the Council in connection with his attendance at any conference, seminar, or similar meeting conducted for the benefit of the Council.

SEC. 208. The Council may make expenditures in support of its international activities, including expenditures for: (1) international travel; (2) activities in implementation of international agreements; and (3) the support of international exchange programs in the United States and in foreign countries.

SEC. 209. There are authorized to be appropriated to carry out the provisions of this chapter not to exceed $300,000 for fiscal year 1970, $700,000 for fiscal year 1971, and $1,000,000 for each fiscal year thereafter.

APPENDIX B

THE ENVIRONMENTAL QUALITY IMPROVEMENT ACT OF 1970*

TITLE II—ENVIRONMENTAL QUALITY (OF THE WATER QUALITY IMPROVEMENT ACT OF 1974)

SHORT TITLE

SEC. 201. This title may be cited as the "Environmental Quality Improvement Act of 1970."

FINDINGS, DECLARATIONS, AND PURPOSES

SEC. 202. (a) The Congress finds—

(1) That man has caused changes in the environment;

(2) That many of these changes may affect the relationship between man and his environment; and

(3) That population increases and urban concentration contribute directly to pollution and the degradation of our environment.

(b)(1) The Congress declares that there is a national policy for the environment which provides for the enhancement of environmental quality. This policy is evidenced by statutes heretofore enacted relating to the prevention, abatement, and control of environmental pollution, water and land resources, transportation, and economic and regional development.

(2) The primary responsibility for implementing this policy rests with State and local governments.

(3) The Federal Government encourages and supports implementation of this policy through appropriate regional organizations established under existing law.

(c) The purposes of this title are—

(1) To assure that each Federal department and agency conducting or supporting public works activities which affect the environment shall implement the policies established under existing law; and

(2) To authorize an Office of Environmental Quality, which, notwithstanding any other provision of law, shall provide the professional and administrative staff for the Council on Environmental Quality established by Public Law 91–190.

OFFICE OF ENVIRONMENTAL QUALITY

SEC. 203. (a) There is established in the Executive Office of the President an office to be known as the Office of Environmental Quality (hereafter in this title referred to as the "Office"). The Chairman of the Council on Environ-

*Pub. L. 91–224, 42 U.S.C. 4371–4374, April 3, 1970.

mental Quality established by Public Law 91–190 shall be the Director of the Office. There shall be in the Office a Deputy Director who shall be appointed by the President, by and with the advice and consent of the Senate.

(b) The compensation of the Deputy Director shall be fixed by the President at a rate not in excess of the annual rate of compensation payable to the Deputy Director of the Bureau of the Budget.

(c) The Director is authorized to employ such officers and employees (including experts and consultants) as may be necessary to enable the Office to carry out its functions under this title and Public Law 91–190, except that he may employ no more than 10 specialists and other experts without regard to the provisions of title 5, United States Code, governing appointments in the competitive service, and pay such specialists and experts without regard to the provisions of chapter 51 and subchapter 111 of chapter 53 of such title relating to classification and General Schedule pay rates, but no such specialist or expert shall be paid at a rate in excess of the maximum rate for GS–18 of the General Schedule under section 5330 of title 5.

(d) In carrying out his functions the Director shall assist and advise the President on policies and programs of the Federal Government affecting environmental quality by—

(1) Providing the professional and administrative staff and support for the Council on Environmental Quality established by Public Law 91–190;

(2) Assisting the Federal agencies and departments in appraising the effectiveness of existing and proposed facilities, programs, policies, and activities of the Federal Government, and those specific major projects designated by the President which do not require individual project authorization by Congress, which affect environmental quality;

(3) Reviewing the adequacy of existing systems for monitoring and predicting environmental changes in order to achieve effective coverage and efficient use of research facilities and other resources;

(4) Promoting the advancement of scientific knowledge of the effects of actions and technology on the environment and encourage the development of the means to prevent or reduce adverse effects that endanger the health and well-being of man;

(5) Assisting in coordinating among the Federal departments and agencies those programs and activities which affect, protect, and improve environmental quality;

(6) Assisting the Federal departments and agencies in the development and interrelationship of environmental quality criteria and standards established through the Federal Government;

(7) Collecting, collating, analyzing, and interpreting data and information on environmental quality, ecological research, and evaluation.

(e) The Director is authorized to contract with public or private agencies, institutions, and organizations and with individuals without regard to sections 3618 and 3709 of the Revised Statutes (31 U.S.C. 529; 41 U.S.C. 5) in carrying out his functions.

REPORT

SEC. 204. Each Environmental Quality Report required by Public Law 91–190 shall, upon transmittal to Congress, be referred to each standing committee having jurisdiction over any part of the subject matter of the Report.

AUTHORIZATION

SEC. 205. There are hereby authorized to be appropriated not to exceed $500,000 for the fiscal year ending June 30, 1970, not to exceed $750,000 for

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the fiscal year ending June 30, 1971, not to exceed $1,250,000 for the fiscal year ending June 30, 1972, and not to exceed $1,500,000 for the fiscal year ending June 30, 1973. These authorizations are in addition to those contained in Public Law 91–190.

Approved April 3, 1970.

APPENDIX C

PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS: GUIDELINES*

On May 2, 1973, the Council on Environmental Quality published in the FEDERAL REGISTER, for public comment, a proposed revision of its guidelines for the preparation of environmental impact statements. Pursuant to the National Environmental Policy Act (P.L. 91–190, 42 U.S.C. 4321 et seq.) and Executive Order 11514 (35 FR 4247) all Federal departments, agencies, and establishments are required to prepare such statements in connection with their proposals for legislation and other major Federal actions significantly affecting the quality of the human environment. The authority for the Council's guidelines is set forth below in § 1500.1. The specific policy to be implemented by the guidelines is set forth below in § 1500.2.

The Council received numerous comments on its proposed guidelines from environmental groups, Federal, State, and local agencies, industry, and private individuals. Two general themes were presented in the majority of the comments. First, the Council should increase the opportunity for public involvement in the impact statement process. Second, the Council should provide more detailed guidance on the responsibilities of Federal agencies in light of recent court decisions interpreting the Act. The proposed guidelines have been revised in light of the specific comments relating to these general themes, as well as other comments received, and are now being issued in final form.

The guidelines will appear in the Code of Federal Regulations in Title 40, Chapter V, at Part 1500. They are being codified, in part, because they affect State and local governmental agencies, environmental groups, industry, and private individuals, in addition to Federal agencies, to which they are specifically directed, and the resultant need to make them widely and readily available.

Sec.

1500.1 Purpose and authority.
1500.2 Policy.
1500.3 Agency and OMB procedures.
1500.4 Federal agencies included: effect of the act on existing agency mandates.
1500.5 Types of actions covered by the act.
1500.6 Identifying major actions significantly affecting the environment.
1500.7 Preparing draft environmental statements; public hearings.
1500.8 Content of environmental statements.
1500.9 Review of draft environmental statements by Federal, Federal-State, State, and local agencies and by the public.
1500.10 Preparation and circulation of final environmental statements.
1500.11 Transmittal of statements to the Council; minimum periods for review; requests by the Council.

*38 Fed. Reg. 20550–20562 (1973).

Sec.

1500.12 Legislative actions.
1500.13 Application of section 102(2)(C) procedure to existing projects and programs.
1500.14 Supplementary guidelines; evaluation of procedures.

Appendix I Summary to accompany draft and final statements.
Appendix II Areas of environmental impact and Federal agencies and Federal-State agencies with jurisdiction by law or special expertise to comment thereon.
Appendix III Offices within Federal agencies and Federal-State agencies for information regarding the agencies' NEPA activities and for receiving other agencies' impact statements for which comments are requested.
Appendix IV State and local agency review of impact statements.

AUTHORITY: National Environmental Policy Act (P.L. 91–190, 42 U.S.C. 4321 et seq.) and Executive Order 11514.

§ 1500.1 PURPOSE AND AUTHORITY

(a) This directive provides guidelines to Federal departments, agencies, and establishments for preparing detailed environmental statements on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment as required by section 102(2)(C) of the National Environmental Policy Act (P.L. 91–190, 42 U.S.C. 4321 et seq., hereafter "the Act"). Underlying the preparation of such environmental statements is the mandate of both the Act and Executive Order 11514 (35 FR 4247) of March 5, 1970, that all Federal agencies, to the fullest extent possible, direct their policies, plans and programs to protect and enhance environmental quality. Agencies are required to view their actions in a manner calculated to encourage productive and enjoyable harmony between man and his environment, to promote efforts preventing or eliminating damage to the environment and biosphere and stimulating the health and welfare of man, and to enrich the understanding of the ecological systems and natural resources important to the Nation. The objective of section 102(2)(C) of the Act and of these guidelines is to assist agencies in implementing these policies. This requires agencies to build into their decisionmaking process, beginning at the earliest possible point, an appropriate and careful consideration of the environmental aspects of proposed action in order that adverse environmental effects may be avoided or minimized and environmental quality previously lost may be restored. This directive also provides guidance to Federal, State, and local agencies and the public in commenting on statements prepared under these guidelines.

(b) Pursuant to section 204(3) of the Act the Council on Environmental Quality (hereafter "the Council") is assigned the duty and function of reviewing and appraising the programs and activities of the Federal Government, in the light of the Act's policy, for the purpose of determining the extent to which such programs and activities are contributing to the achievement of such policy, and to make recommendations to the President with respect thereto. Section 102(2)(B) of the Act directs all Federal agencies to identify and develop methods and procedures, in consultation with the Council, to insure that unquantified environmental values be given appropriate consideration in decisionmaking along with economic and technical considerations; section 102(2)(C) of the Act directs that copies of all environmental impact statements be filed with the Council; and section 102(2)(H) directs all Federal agencies to assist the Council in the performance of its functions. These provisions have been supplemented in sections 3 (h) and (i) of Executive Order 11514 by direction that the Council issue guidelines to Federal

agencies for preparation of environmental impact statements and such other instructions to agencies and requests for reports and information as may be required to carry out the Council's responsibilities under the Act.

§ 1500.2 POLICY

(a) As early as possible and in all cases prior to agency decision concerning recommendations or favorable reports on proposals for (1) legislation significantly affecting the quality of the human environment (see §§ 1500.5(i) and 1500.12) (hereafter "legislative actions") and (2) all other major Federal actions significantly affecting the quality of the human environment (hereafter "administrative actions"), Federal agencies will, in consultation with other appropriate Federal, State and local agencies and the public assess in detail the potential environmental impact.

(b) Initial assessments of the environmental impacts of proposed action should be undertaken concurrently with initial technical and economic studies and, where required, a draft environmental impact statement prepared and circulated for comment in time to accompany the proposal through the existing agency review processes for such action. In this process, Federal agencies shall: (1) Provide for circulation of draft environmental statements to other Federal, State, and local agencies and for their availability to the public in accordance with the provisions of these guidelines; (2) consider the comments of the agencies and the public; and (3) issue final environmental impact statements responsive to the comments received. The purpose of this assessment and consultation process is to provide agencies and other decisionmakers as well as members of the public with an understanding of the potential environmental effects of proposed actions, to avoid or minimize adverse effects wherever possible, and to restore or enhance environmental quality to the fullest extent practicable. In particular, agencies should use the environmental impact statement process to explore alternative actions that will avoid or minimize adverse impacts and to evaluate both the long- and short-range implications of proposed actions to man, his physical and social surroundings, and to nature. Agencies should consider the results of their environmental assessments along with their assessments of the net economic, technical and other benefits of proposed actions and use all practicable means, consistent with other essential considerations of national policy, to restore environmental quality as well as to avoid or minimize undesirable consequences for the environment.

§ 1500.3 AGENCY AND OMB PROCEDURES

(a) Pursuant to section 2(f) of Executive Order 11514, the heads of Federal agencies have been directed to proceed with measures required by section 102(2)(C) of the Act. Previous guidelines of the Council directed each agency to establish its own formal procedures for (1) identifying those agency actions requiring environmental statements, the appropriate time prior to decision for the consultations required by section 102(2)(C) and the agency review process for which environmental statements are to be available, (2) obtaining information required in their preparation, (3) designating the officials who are to be responsible for the statements, (4) consulting with and taking account of the comments of appropriate Federal, State and local agencies and the public, including obtaining the comment of the Administrator of the Environmental Protection Agency when required under section 309 of the Clean Air Act, as amended, and (5) meeting the requirements of section 2(b) of Executive Order 11514 for providing timely public information on Federal plans and programs with environmental impact. Each agency, including both departmental and subdepartmental components having such procedures, shall

review its procedures and shall revise them, in consultation with the Council, as may be necessary in order to respond to requirements imposed by these revised guidelines as well as by such previous directions. After such consultation, proposed revisions of such agency procedures shall be published in the FEDERAL REGISTER no later than October 30, 1973. A minimum 45-day period for public comment shall be provided, followed by publication of final procedures no later than forty-five (45 days) after the conclusion of the comment period. Each agency shall submit seven (7) copies of all such procedures to the Council. Any future revision of such agency procedures shall similarly be proposed and adopted only after prior consultation with the Council and, in the case of substantial revision, opportunity for public comment. All revisions shall be published in the FEDERAL REGISTER.

(b) Each Federal agency should consult, with the assistance of the Council and the Office of Management and Budget if desired, with other appropriate Federal agencies in the development and revision of the above procedures so as to achieve consistency in dealing with similar activities and to assure effective coordination among agencies in their review of proposed activities. Where applicable State and local review of such agency procedures should be conducted pursuant to procedures established by Office of Management and Budget Circular No. A–85.

(c) Existing mechanisms for obtaining the views of Federal, State, and local agencies on proposed Federal actions should be utilized to the maximum extent practicable in dealing with environmental matters. The Office of Management and Budget will issue instructions, as necessary, to take full advantage of such existing mechanisms.

§ 1500.4 FEDERAL AGENCIES INCLUDED; EFFECT OF THE ACT ON EXISTING AGENCY MANDATES

(a) Section 102(2)(C) of the Act applies to all agencies of the Federal Government. Section 102 of the Act provides that "to the fullest extent possible: (1) The policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in this Act," and section 105 of the Act provides that "the policies and goals set forth in this Act are supplementary to those set forth in existing authorizations of Federal agencies." This means that each agency shall interpret the provisions of the Act as a supplement to its existing authority and as a mandate to view traditional policies and missions in the light of the Act's national environmental objectives. In accordance with this purpose, agencies should continue to review their policies, procedures, and regulations and to revise them as necessary to ensure full compliance with the purposes and provisions of the Act. The phrase "to the fullest extent possible" in section 102 is meant to make clear that each agency of the Federal Government shall comply with that section unless existing law applicable to the agency's operations expressly prohibits or makes compliance impossible.

§ 1500.5 TYPES OF ACTIONS COVERED BY THE ACT

(a) "Actions" include but are not limited to:

(1) Recommendations or favorable reports relating to legislation including requests for appropriations. The requirement for following the section 102 (2)(C) procedure as elaborated in these guidelines applies to both (i) agency recommendations on their own proposals for legislation (see § 1500.12); and (ii) agency reports on legislation initiated elsewhere. In the latter case only the agency which has primary responsibility for the subject matter involved will prepare an environmental statement.

(2) New and continuing projects and program activities: directly undertaken by Federal agencies; or supported in whole or in part through Federal contracts, grants, subsidies, loans, or other forms of funding assistance (except where such assistance is solely in the form of general revenue sharing funds, distributed under the State and Local Fiscal Assistance Act of 1972, 31 U.S.C. 1221 et seq. with no Federal agency control over the subsequent use of such funds); or involving a Federal lease, permit, license certificate or other entitlement for use.

(3) The making, modification, or establishment of regulations, rules, procedures, and policy.

§ 1500.6 IDENTIFYING MAJOR ACTIONS SIGNIFICANTLY AFFECTING THE ENVIRONMENT

(a) The statutory clause "major Federal actions significantly affecting the quality of the human environment" is to be construed by agencies with a view to the overall, cumulative impact of the action proposed, related Federal actions and projects in the area, and further actions contemplated. Such actions may be localized in their impact, but if there is potential that the environment may be significantly affected, the statement is to be prepared. Proposed major actions, the environmental impact of which is likely to be highly controversial, should be covered in all cases. In considering what constitutes major action significantly affecting the environment, agencies should bear in mind that the effect of many Federal decisions about a project or complex of projects can be individually limited but cumulatively considerable. This can occur when one or more agencies over a period of years puts into a project individually minor but collectively major resources, when one decision involving a limited amount of money is a precedent for action in much larger cases or represents a decision in principle about a future major course of action, or when several Government agencies individually make decisions about partial aspects of a major action. In all such cases, an environmental statement should be prepared if it is reasonable to anticipate a cumulatively significant impact on the environment from Federal action. The Council, on the basis of a written assessment of the impacts involved, is available to assist agencies in determining whether specific actions require impact statements.

(b) Section 101(b) of the Act indicates the broad range of aspects of the environment to be surveyed in any assessment of significant effect. The Act also indicates that adverse significant effects include those that degrade the quality of the environment, curtail the range of beneficial uses of the environment, and serve short-term, to the disadvantage of long-term, environmental goals. Significant effects can also include actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial. Significant effects also include secondary effects, as described more fully, for example, in § 1500.8(a)(iii)(B). The significance of a proposed action may also vary with the setting, with the result that an action that would have little impact in an urban area may be significant in a rural setting or vice versa. While a precise definition of environmental "significance," valid in all contexts, is not possible, effects to be considered in assessing significance include, but are not limited to, those outlined in Appendix II of these guidelines.

(c) Each of the provisions of the Act, except section 102(2)(C), applies to all Federal agency actions. Section 102(2)(C) requires the preparation of a detailed environmental impact statement in the case of "major Federal actions significantly affecting the quality of the human environment." The identification of major actions significantly affecting the environment is the responsibility of each Federal agency, to be carried out against the background

of its own particular operations. The action must be a (1) "major" action, (2) which is a "Federal action," (3) which has a "significant" effect, and (4) which involves the "quality of the human environment." The words "major" and "significantly" are intended to imply thresholds of importance and impact that must be met before a statement is required. The action causing the impact must also be one where there is sufficient Federal control and responsibility to constitute "Federal action" in contrast to cases where such Federal control and responsibility are not present as, for example, when Federal funds are distributed in the form of general revenue sharing to be used by State and local governments (see § 1500.5a(ii)). Finally, the action must be one that significantly affects the quality of the human environment either by directly affecting human beings or by indirectly affecting human beings through adverse effects on the environment. Each agency should review the typical classes of actions that it undertakes and, in consultation with the Council, should develop specific criteria and methods for identifying those actions likely to require environmental statements and those actions likely not to require environmental statements. Normally this will involve:

(i) Making an initial assessment of the environmental impacts typically associated with principal types of agency action.

(ii) Identifying on the basis of this assessment, types of actions which normally do, and types of actions which normally do not, require statements.

(iii) With respect to remaining actions that may require statements depending on the circumstances, and those actions determined under the preceding paragraph (ii) of this section as likely to require statements, identifying: (*a*) what basic information needs to be gathered; (*b*) how and when such information is to be assembled and analyzed; and (*c*) on what bases environmental assessments and decisions to prepare impact statements will be made. Agencies may either include this substantive guidance in the procedures issued pursuant to § 1500.3(a) of these guidelines, or issue such guidance as supplemental instructions to aid relevant agency personnel in implementing the impact statement process. Pursuant to § 1500.14 of these guidelines, agencies shall report to the Council by June 30, 1974, on the progress made in developing such substantive guidance.

(d)(1) Agencies should give careful attention to identifying and defining the purpose and scope of the action which would most appropriately serve as the subject of the statement. In many cases, broad program statements will be required in order to assess the environmental effects of a number of individual actions on a given geographical area (e.g., coal leases), or environmental impacts that are generic or common to a series of agency actions (e.g., maintenance or waste handling practices), or the overall impact of a large-scale program or chain of contemplated projects (e.g., major lengths of highway as opposed to small segments). Subsequent statements on major individual actions will be necessary where such actions have significant environmental impacts not adequately evaluated in the program statement.

(2) Agencies engaging in major technology research and development programs should develop procedures for periodic evaluation to determine when a program statement is required for such programs. Factors to be considered in making this determination include the magnitude of Federal investment in the program, the likelihood of widespread application of the technology, the degree of environmental impact which would occur if the technology were widely applied, and the extent to which continued investment in the new technology is likely to restrict future alternatives. Statements must be written late enough in the development process to contain meaningful information, but early enough so that this information can practically serve as an input in the decision-making process. Where it is anticipated that a statement may ultimately be required but that its preparation is still premature, the agency should prepare an evaluation briefly setting forth the reasons for its determi-

nation that a statement is not yet necessary. This evaluation should be periodically updated, particularly when significant new information becomes available concerning the potential environmental impact of the program. In any case, a statement must be prepared before research activities have reached a stage of investment or commitment to implementation likely to determine subsequent development or restrict later alternatives. Statements on technology research and development programs should include an analysis not only of alternative forms of the same technology that might reduce any adverse environmental impacts but also of alternative technologies that would serve the same function as the technology under consideration. Efforts should be made to involve other Federal agencies and interested groups with relevant expertise in the preparation of such statements because the impacts and alternatives to be considered are likely to be less well defined than in other types of statements.

(e) In accordance with the policy of the Act and Executive Order 11514 agencies have a responsibility to develop procedures to insure the fullest practicable provision of timely public information and understanding of Federal plans and programs with environmental impact in order to obtain the views of interested parties. In furtherance of this policy, agency procedures should include an appropriate early notice system for informing the public of the decision to prepare a draft environmental statement on proposed administrative actions (and for soliciting comments that may be helpful in preparing the statement) as soon as is practicable after the decision to prepare the statement is made. In this connection, agencies should: (1) maintain a list of administrative actions for which environmental statements are being prepared; (2) revise the list at regular intervals specified in the agency's procedures developed pursuant to § 1500.3(a) of these guidelines (but not less than quarterly) and transmit each such revision to the Council; and (3) make the list available for public inspection on request. The Council will periodically publish such lists in the FEDERAL REGISTER. If an agency decides that an environmental statement is not necessary for a proposed action (i) which the agency has identified pursuant to § 1500.6(c)(ii) as normally requiring preparation of a statement, (ii) which is similar to actions for which the agency has prepared a significant number of statements, (iii) which the agency has previously announced would be the subject of a statement, or (iv) for which the agency has made a negative determination in response to a request from the Council pursuant to § 1500.11(f), the agency shall prepare a publicly available record briefly setting forth the agency's decision and the reasons for that determination. Lists of such negative determinations, and any evaluations made pursuant to § 1500.6 which conclude that preparation of a statement is not yet timely, shall be prepared and made available in the same manner as provided in this subsection for lists of statements under preparation.

§ 1500.7 PREPARING DRAFT ENVIRONMENTAL STATEMENTS; PUBLIC HEARINGS

(a) Each environmental impact statement shall be prepared and circulated in draft form for comment in accordance with the provisions of these guidelines. The draft statement must fulfill and satisfy to the fullest extent possible at the time the draft is prepared the requirements established for final statements by section 102(2)(C). (Where an agency has an established practice of declining to favor an alternative until public comments on a proposed action have been received, the draft environmental statement may indicate that two or more alternatives are under consideration.) Comments received shall be carefully evaluated and considered in the decision process. A final statement with substantive comments attached shall then be issued and circulated in accordance with applicable provisions of §§ 1500.10, 1500.11,

or 1500.12. It is important that draft environmental statements be prepared and circulated for comment and furnished to the Council as early as possible in the agency review process in order to permit agency decisionmakers and outside reviewers to give meaningful consideration to the environmental issues involved. In particular, agencies should keep in mind that such statements are to serve as the means of assessing the environmental impact of proposed agency actions, rather than as a justification for decisions already made. This means that draft statements on administrative actions should be prepared and circulated for comment prior to the first significant point of decision in the agency review process. For major categories of agency action, this point should be identified in the procedures issued pursuant to § 1500.3(a). For major categories of projects involving an applicant and identified pursuant to § 1500.6(c)(ii) as normally requiring the preparation of a statement, agencies should include in their procedures provisions limiting actions which an applicant is permitted to take prior to completion and review of the final statement with respect to his application.

(b) Where more than one agency (1) directly sponsors an action, or is directly involved in an action through funding, licenses, or permits, or (2) is involved in a group of actions directly related to each other because of their functional interdependence and geographical proximity, consideration should be given to preparing one statement for all the Federal actions involved (see § 1500.6(d)(1)). Agencies in such cases should consider the possibility of joint preparation of a statement by all agencies concerned, or designation of a single "lead agency" to assume supervisory responsibility for preparation of the statement. Where a lead agency prepares the statement, the other agencies involved should provide assistance with respect to their areas of jurisdiction and expertise. In either case, the statement should contain an environmental assessment of the full range of Federal actions involved, should reflect the views of all participating agencies, and should be prepared before major or irreversible actions have been taken by any of the participating agencies. Factors relevant in determining an appropriate lead agency include the time sequence in which the agencies become involved, the magnitude of their respective involvement, and their relative expertise with respect to the project's environmental effects. As necessary, the Council will assist in resolving questions of responsibility for statement preparation in the case of multi-agency actions. Federal Regional Councils, agencies and the public are encouraged to bring to the attention of the Council and other relevant agencies appropriate situations where a geographic or regionally focused statement would be desirable because of the cumulative environmental effects likely to result from multi-agency actions in the area.

(c) Where an agency relies on an applicant to submit initial environmental information, the agency should assist the applicant by outlining the types of information required. In all cases, the agency should make its own evaluation of the environmental issues and take responsibility for the scope and content of draft and final environmental statements.

(d) Agency procedures developed pursuant to § 1500.3(a) of these guidelines should indicate as explicitly as possible those types of agency decisions or actions which utilize hearings as part of the normal agency review process, either as a result of statutory requirement or agency practice. To the fullest extent possible, all such hearings shall include consideration of the environmental aspects of the proposed action. Agency procedures shall also specifically include provision for public hearings on major actions with environmental impact, whenever appropriate, and for providing the public with relevant information, including information on alternative courses of action. In deciding whether a public hearing is appropriate, an agency should consider: (1) the magnitude of the proposal in terms of economic costs, the geographic area involved, and the uniqueness or size of commitment of the resources involved; (2) the degree of interest in the proposal, as evidenced by requests from the public and from Federal, State and local authorities that a hearing

be held; (3) the complexity of the issue and the likelihood that information will be presented at the hearing which will be of assistance to the agency in fulfilling its responsibilities under the Act; and (4) the extent to which public involvement already has been achieved through other means, such as earlier public hearings, meetings with citizen representatives, and/or written comments on the proposed action. Agencies should make any draft environmental statements to be issued available to the public at least fifteen (15) days prior to the time of such hearings.

§ 1500.8 CONTENT OF ENVIRONMENTAL STATEMENTS

(a) The following points are to be covered:

(1) A description of the proposed action, a statement of its purposes, and a description of the environment affected, including information, summary technical data, and maps and diagrams where relevant, adequate to permit an assessment of potential environmental impact by commenting agencies and the public. Highly technical and specialized analyses and data should be avoided in the body of the draft impact statement. Such materials should be attached as appendices or footnoted with adequate bibliographic references. The statement should also succinctly describe the environment of the area affected as it exists prior to a proposed action, including other Federal activities in the area affected by the proposed action which are related to the proposed action. The interrelationships and cumulative environmental impacts of the proposed action and other related Federal projects shall be presented in the statement. The amount of detail provided in such descriptions should be commensurate with the extent and expected impact of the action, and with the amount of information required at the particular level of decisionmaking (planning, feasibility, design, etc.). In order to ensure accurate descriptions and environmental assessments, site visits should be made where feasible. Agencies should also take care to-identify, as appropriate, population and growth characteristics of the affected area and any population and growth assumptions used to justify the project or program or to determine secondary population and growth impacts resulting from the proposed action and its alternatives (see paragraph (3)(ii), of this section). In discussing these population aspects, agencies should give consideration to using the rates of growth in the region of the project contained in the projection compiled for the Water Resources Council by the Bureau of Economic Analysis of the Department of Commerce and the Economic Research Service of the Department of Agriculture (the "OBERS" projection). In any event it is essential that the sources of data used to identify, quantify or evaluate any and all environmental consequences be expressly noted.

(2) The relationship of the proposed action to land use plans, policies, and controls for the affected area. This requires a discussion of how the proposed action may conform or conflict with the objectives and specific terms of approved or proposed Federal, State, and local land use plans, policies and controls, if any, for the area affected, including those developed in response to the Clean Air Act or the Federal Water Pollution Control Act Amendments of 1972. Where a conflict or inconsistency exists, the statement should describe the extent to which the agency has reconciled its proposed action with the plan, policy or control and the reasons why the agency has decided to proceed notwithstanding the absence of full reconciliation.

(3) The probable impact of the proposed action on the environment.

(i) This requires agencies to assess the positive and negative effects of the proposed action as it affects both the national and international environment. The attention given to different environmental factors will vary according to the nature, scale, and location of proposed actions. Among factors to consider should be the potential effect of the action on such aspects of the environment as those listed in Appendix II of these guidelines. Primary attention

should be given in the statement to discussing those factors most evidently impacted by the proposed action.

(ii) Secondary or indirect, as well as primary or direct, consequences for the environment should be included in the analysis. Many major Federal actions, in particular those that involve the construction or licensing of infrastructure investments (e.g., highways, airports, sewer systems, water resource projects, etc.), stimulate or induce secondary effects in the form of associated investments and changed patterns of social and economic activities. Such secondary effects, through their impacts on existing community facilities and activities, through inducing new facilities and activities, or through changes in natural conditions, may often be even more substantial than the primary effects of the original action itself. For example, the effects of the proposed action on population and growth may be among the more significant secondary effects. Such population and growth impacts should be estimated if expected to be significant (using data identified as indicated in § 1500.8(a)(1)) and an assessment made of the effect of any possible change in population patterns or growth upon the resource base, including land use, water, and public services, of the area in question.

(4) Alternatives to the proposed action, including, where relevant, those not within the existing authority of the responsible agency. (Section 102(2)(D) of the Act requires the responsible agency to "study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources"). A rigorous exploration and objective evaluation of the environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential. Sufficient analysis of such alternatives and their environmental benefits, costs and risks should accompany the proposed action through the agency review process in order not to foreclose prematurely options which might enhance environmental quality or have less detrimental effects. Examples of such alternatives include: the alternative of taking no action or of postponing action pending further study; alternatives requiring actions of a significantly different nature which would provide similar benefits with different environmental impacts (e.g., nonstructural alternatives to flood control programs, or mass transit alternatives to highway construction); alternatives related to different designs or details of the proposed action which would present different environmental impacts (e.g., cooling ponds vs. cooling towers for a power plant or alternatives that will significantly conserve energy); alternative measures to provide for compensation of fish and wildlife losses, including the acquisition of land, waters, and interests therein. In each case, the analysis should be sufficiently detailed to reveal the agency's comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative. Where an existing impact statement already contains such an analysis, its treatment of alternatives may be incorporated provided that such treatment is current and relevant to the precise purpose of the proposed action.

(5) Any probable adverse environmental effects which cannot be avoided (such as water or air pollution, undesirable land use patterns, damage to life systems, urban congestion, threats to health or other consequences adverse to the environmental goals set out in section 101(b) of the Act). This should be a brief section summarizing in one place those effects discussed in paragraph (a)(3) of this section that are adverse and unavoidable under the proposed action. Included for purposes of contrast should be a clear statement of how other avoidable adverse effects discussed in paragraph (a)(2) of this section will be mitigated.

(6) The relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity. This section should contain a brief discussion of the extent to which the proposed action involves tradeoffs between short-term environmental gains at the expense

of long-term losses, or vice versa, and a discussion of the extent to which the proposed action forecloses future options. In this context short-term and long-term do not refer to any fixed time periods, but should be viewed in terms of the environmentally significant consequences of the proposed action.

(7) Any irreversible and irretrievable commitments of resources that would be involved in the proposed action should it be implemented. This requires the agency to identify from its survey unavoidable impacts in paragraph (a)(5) of this section the extent to which the action irreversibly curtails the range of potential uses of the environment. Agencies should avoid construing the term "resources" to mean only the labor and materials devoted to an action. "Resources" also means the natural and cultural resources committed to loss or destruction by the action.

(8) An indication of what other interests and considerations of Federal policy are thought to offset the adverse environmental effects of the proposed action identified pursuant to paragraphs (a)(3) and (5) of this section. The statement should also indicate the extent to which these stated countervailing benefits could be realized by following reasonable alternatives to the proposed action (as identified in paragraph (a)(4) of this section) that would avoid some or all of the adverse environmental effects. In this connection, agencies that prepare cost-benefit analyses of proposed actions should attach such analyses, or summaries thereof, to the environmental impact statement, and should clearly indicate the extent to which environmental costs have not been reflected in such analyses.

(b) In developing the above points agencies should make every effort to convey the required information succinctly in a form easily understood, both by members of the public and by public decisionmakers, giving attention to the substance of the information conveyed rather than to the particular form, or length, or detail of the statement. Each of the above points, for example, need not always occupy a distinct section of the statement if it is otherwise adequately covered in discussing the impact of the proposed action and its alternatives—which items should normally be the focus of the statement. Draft statements should indicate at appropriate points in the text any underlying studies, reports, and other information obtained and considered by the agency in preparing the statement including any cost-benefit analyses prepared by the agency, and reports of consulting agencies under the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq., and the National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq., where such consultation has taken place. In the case of documents not likely to be easily accessible (such as internal studies or reports), the agency should indicate how such information may be obtained. If such information is attached to the statement, care should be taken to ensure that the statement remains an essentially self-contained instrument, capable of being understood by the reader without the need for undue cross reference.

(c) Each environmental statement should be prepared in accordance with the precept in section 102(2)(A) of the Act that all agencies of the Federal Government "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and decisionmaking which may have a impact on man's environment." Agencies should attempt to have relevant disciplines represented on their own staffs; where this is not feasible they should make appropriate use of relevant Federal, State, and local agencies or the professional services of universities and outside consultants. The interdisciplinary approach should not be limited to the preparation of the environmental impact statement, but should also be used in the early planning stages of the proposed action. Early application of such an approach should help assure a systematic evaluation of reasonable alternative courses of action and their potential social, economic, and environmental consequences.

(d) Appendix I prescribes the form of the summary sheet which should accompany each draft and final environmental statement.

§ 1500.9 REVIEW OF DRAFT ENVIRONMENTAL STATEMENTS BY FEDERAL, FEDERAL–STATE, STATE, AND LOCAL AGENCIES AND BY THE PUBLIC

(a) *Federal agency review: In general.* A Federal agency considering an action requiring an environmental statement should consult with, and (on the basis of a draft environmental statement for which the agency takes responsibility) obtain the comment on the environmental impact of the action of Federal and Federal-State agencies with jurisdiction by law or special expertise with respect to any environmental impact involved. These Federal and Federal-State agencies and their relevant areas of expertise include those identified in Appendices II and III to these guidelines. It is recommended that the listed departments and agencies establish contact points, which may be regional offices, for providing comments on the environmental statements. The requirement in section 102(2)(C) to obtain comment from Federal agencies having jurisdiction or special expertise is in addition to any specific statutory obligation of any Federal agency to coordinate or consult with any other Federal or State agency. Agencies should, for example, be alert to consultation requirements of the Fish and Wildlife Coordination Act, 16 U.S.C. 661 et seq., and the National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq. To the extent possible, statements or findings concerning environmental impact required by other statutes, such as section 4(f) of the Department of Transportation Act of 1966, 49 U.S.C. 1653(f), or section 106 of the National Historic Preservation Act of 1966, should be combined with compliance with the environmental impact statement requirements of section 102(2)(C) of the Act to yield a single document which meets all applicable requirements. The Advisory Council on Historic Preservation, the Department of Transportation, and the Department of Interior, in consultation with the Council, will issue any necessary supplementing instructions for furnishing information or findings not forthcoming under the environmental impact statement process.

(b) *EPA review:* Section 309 of the Clean Air Act, as amended (42 U.S.C. § 1857h–7), provides that the Administrator of the Environmental Protection Agency shall comment in writing on the environmental impact of any matter relating to his duties and responsibilities, and shall refer to the Council any matter that the Administrator determines is unsatisfactory from the standpoint of public health or welfare or environmental quality. Accordingly, wherever an agency action related to air or water quality, noise abatement and control, pesticide regulation, solid waste disposal, generally applicable environmental radiation criteria and standards, or other provision of the authority of the Administrator involved, Federal agencies are required to submit such proposed actions and their environmental impact statements, if such have been prepared, to the Administrator for review and comment in writing. In all cases where EPA determines that proposed agency action is environmentally unsatisfactory, or where EPA determines that an environmental statement is so inadequate that such a determination cannot be made, EPA shall publish its determination and notify the Council as soon as practicable. The Administrator's comments shall constitute his comments for the purposes of both section 309 of the Clean Air Act and section 102(2)(C) of the National Environmental Policy Act.

(c) *State and local review:* Office of Management and Budget Circular No. A–95 (Revised) through its system of State and areawide clearinghouses provides a means for securing the views of State and local environmental agencies, which can assist in the preparation and review of environmental impact statements. Current instructions for obtaining the views of such agencies are contained in the joint OMB–CEQ memorandum attached to these guidelines as Appendix IV. A current listing of clearinghouses is issued periodically by the Office of Management and Budget.

(d) *Public review:* The procedures established by these guidelines are designed to encourage public participation in the impact statement process at the earliest possible time. Agency procedures should make provision for facilitating the comment of public and private organizations and indviduals by announcing the availability of draft environmental statements and by making copies available to organizations and individuals that request an opportunity to comment. Agencies should devise methods for publicizing the existence of draft statements, for example, by publication of notices in local newspapers or by maintaining a list of groups, including relevant conservation commissions, known to be interested in the agency's activities and directly notifying such groups of the existence of a draft statement, or sending them a copy, as soon as it has been prepared. A copy of the draft statement should in all cases be sent to any applicant whose project is the subject of the statement. Materials to be made available to the public shall be provided without charge to the extent practicable, or at a fee which is not more than the actual cost of reproducing copies required to be sent to other Federal agencies, including the Council.

(e) *Responsibilities of commenting entities:* (1) Agencies and members of the public submitting comments on proposed actions on the basis of draft environmental statements should endeavor to make their comments as specific, substantive, and factual as possible without undue attention to matters of form in the impact statement. Although the comments need not conform to any particular format, it would assist agencies reviewing comments if the comments were organized in a manner consistent with the structure of the draft statement. Emphasis should be placed on the assessment of the environmental impacts of the proposed action, and the acceptability of those impacts on the quality of the environment, particularly as contrasted with the impacts of reasonable alternatives to the action. Commenting entities may recommend modifications to the proposed action and/or new alternatives that will enhance environmental quality and avoid or minimize adverse environmental impacts.

(2) Commenting agencies should indicate whether any of their projects not identified in the draft statement are sufficiently advanced in planning and related environmentally to the proposed action so that a discussion of the environmental interrelationships should be included in the final statement (see § 1500.8(a)(1)). The Council is available to assist agencies in making such determinations.

(3) Agencies and members of the public should indicate in their comments the nature of any monitoring of the environmental effects of the proposed project that appears particularly appropriate. Such monitoring may be necessary during the construction, startup, or operation phases of the project. Agencies with special expertise with respect to the environmental impacts involved are encouraged to assist the sponsoring agency in the establishment and operation of appropriate environmental monitoring.

(f) Agencies seeking comment shall establish time limits of not less than forty-five (45) days for reply, after which it may be presumed, unless the agency or party consulted requests a specified extension of time, that the agency or party consulted has no comment to make. Agencies seeking comment should endeavor to comply with requests for extensions of time of up to fifteen (15) days. In determining an appropriate period for comment, agencies should consider the magnitude and complexity of the statement and the extent of citizen interest in the proposed action.

§ 1500.10 PREPARATION AND CIRCULATION OF FINAL ENVIRONMENTAL STATEMENTS

(a) Agencies should make every effort to discover and discuss all major points of view on the environmental effects of the proposed action and its

alternatives in the draft statement itself. However, where opposing professional views and responsible opinion have been overlooked in the draft statement and are brought to the agency's attention through the commenting process, the agency should review the environmental effects of the action in light of those views and should make a meaningful reference in the final statement to the existence of any responsible opposing view not adequately discussed in the draft statement, indicating the agency's response to the issues raised. All substantive comments received on the draft (or summaries thereof where response has been exceptionally voluminous) should be attached to the final statement, whether or not each such comment is thought to merit individual discussion by the agency in the text of the statement.

(b) Copies of final statements, with comments attached, shall be sent to all Federal, State, and local agencies and private organizations that made substantive comments on the draft statement and to individuals who requested a copy of the final statement, as well as any applicant whose project is the subject of the statement. Copies of final statements shall in all cases be sent to the Environmental Protection Agency to assist it in carrying out its responsibilities under section 309 of the Clean Air Act. Where the number of comments on a draft statement is such that distribution of the final statement to all commenting entities appears impracticable, the agency shall consult with the Council concerning alternative arrangements for distribution of the statement.

§ 1500.11 TRANSMITTAL OF STATEMENTS TO THE COUNCIL; MINIMUM PERIODS FOR REVIEW; REQUESTS BY THE COUNCIL

(a) As soon as they have been prepared, ten (10) copies of draft environmental statements, five (5) copies of all comments made thereon (to be forwarded to the Council by the entity making comment at the time comment is forwarded to the responsible agency), and ten (10) copies of the final text of environmental statements (together with the substance of all comments received by the responsible agency from Federal, State, and local agencies and from private organizations and individuals) shall be supplied to the Council. This will serve to meet the statutory requirement to make environmental statements available to the President. At the same time that copies of draft and final statements are sent to the Council, copies should also be sent to relevant commenting entities as set forth in §§ 1500.9 and 1500.10(b) of these guidelines.

(b) To the maximum extent practicable no administrative action subject to section 102(2)(C) is to be taken sooner than ninety (90) days after a draft environmental statement has been circulated for comment, furnished to the Council and, except where advance public disclosure will result in significantly increased costs of procurement to the Government, made available to the public pursuant to these guidelines; neither should such administrative action be taken sooner than thirty (30) days after the final text of an environmental statement (together with comments) has been made available to the Council, commenting agencies, and the public. In all cases, agencies should allot a sufficient review period for the final statement so as to comply with the statutory requirement that the "statement and the comments and views of appropriate Federal, State, and local agencies * * * accompany the proposal through the existing agency review processes." If the final text of an environmental statement is filed within ninety (90) days after a draft statement has been circulated for comment, furnished to the Council and made public pursuant to this section of these guidelines, the minimum thirty (30) day period and the ninety (90) day period may run concurrently to the extent that they overlap. An agency may at any time supplement or amend

a draft or final environmental statement, particularly when substantial changes are made in the proposed action, or significant new information becomes available concerning its environmental aspects. In such cases the agency should consult with the Council with respect to the possible need or desirability of recirculation of the statement for the appropriate period.

(c) The Council will publish weekly in the FEDERAL REGISTER lists of environmental statements received during the preceding week that are available for public comment. The date of publication of such lists shall be the date from which the minimum periods for review and advance availability of statements shall be calculated.

(d) The Council's publication of notice of the availability of statements is in addition to the agency's responsibility, as described in § 1500.9(d) of these guidelines, to insure the fullest practicable provision of timely public information concerning the existence and availability of environmental statements. The agency responsible for the environmental statement is also responsible for making the statement, the comments received, and any underlying documents available to the public pursuant to the provisions of the Freedom of Information Act (5 U.S.C. 552), without regard to the exclusion of intra- or interagency memoranda when such memoranda transmit comments of Federal agencies on the environmental impact of the proposed action pursuant to § 1500.9 of these guidelines. Agency procedures prepared pursuant to § 1500.3 (a) of these guidelines shall implement these public information requirements and shall include arrangements for availability of environmental statements and comments at the head and appropriate regional offices of the responsible agency and at appropriate State and areawide clearinghouses unless the Governor of the State involved designates to the Council some other point for receipt of this information. Notice of such designation of an alternate point for receipt of this information will be included in the Office of Management and Budget listing of clearinghouses referred to in § 1500.9(c).

(e) Where emergency circumstances make it necessary to take an action with significant environmental impact without observing the provisions of these guidelines concerning minimum periods for agency review and advance availability of environmental statements, the Federal agency proposing to take the action should consult with the Council about alternative arrangements. Similarly where there are overriding considerations of expense to the Government or impaired program effectiveness, the responsible agency should consult with the Council concerning appropriate modifications of the minimum periods.

(f) In order to assist the Council in fulfilling its responsibilities under the Act and under Executive Order 11514, all agencies shall (as required by section 102(2)(H) of the Act and section 3(i) of Executive Order 11514) be resposive to requests by the council for reports and other information dealing with issues arising in connection with the implementaton of the Act. In particular, agencies shall be responsive to a request by the Council for the preparation and circulation of an environmental statement, unless the agency determines that such a statement is not required, in which case the agency shall prepare an environmental assessment and a publicly available record briefly setting forth the reasons for its determination. In no case, however, shall the Council's silence or failure to comment or request preparation, modification, or recirculation of an environmental statement or to take other action with respect to an environmental statement be construed as bearing in any way on the question of the legal requirement for or the adequacy of such statement under the Act.

§ 1500.12 LEGISLATIVE ACTIONS

(a) The Council and the Office of Management and Budget will cooperate in giving guidance as needed to assist agencies in identifying legislative items

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believed to have environmental significance. Agencies should prepare impact statements prior to submission of their legislative proposals to the Office of Management and Budget. In this regard, agencies should identify types of repetitive legislation requiring environmental impact statements (such as certain types of bills affecting transportation policy or annual construction authorizations).

(b) With respect to recommendations or reports on proposals for legislation to which section 102(2)(C) applies, the final text of the environmental statement and comments thereon should be available to the Congress and to the public for consideration in connection with the proposed legislation or report. In cases where the scheduling of congressional hearings on recommendations or reports on proposals for legislation which the Federal agency has forwarded to the Congress does not allow adequate time for the completion of a final text of an environmental statement (together with comments), a draft environmental statement may be furnished to the Congress and made available to the public pending transmittal of the comments as received and the final text.

§ 1500.13 APPLICATION OF SECTION 102(2)(C) PROCEDURE TO EXISTING PROJECTS AND PROGRAMS

Agencies have an obligation to reassess ongoing projects and programs in order to avoid or minimize adverse environmental effects. The section 102(2)(C) procedure shall be applied to further major Federal actions having a significant effect on the environment even though they arise from projects or programs initiated prior to enactment of the Act on January 1, 1970. While the status of the work and degree of completion may be considered in determining whether to proceed with the project, it is essential that the environmental impacts of proceeding are reassessed pursuant to the Act's policies and procedures and, if the project or program is continued, that further incremental major actions be shaped so as to enhance and restore environmental quality as well as to avoid or minimize adverse environmental consequences. It is also important in further action that account be taken of environmental consequences not fully evaluated at the outset of the project or program.

§ 1500.14 SUPPLEMENTARY GUIDELINES; EVALUATION OF PROCEDURES

(a) The Council after examining environmental statements and agency procedures with respect to such statements will issue such supplements to these guidelines as are necessary.

(b) Agencies will continue to assess their experience in the implementation of the section 102(2)(C) provisions of the Act and in conforming with these guidelines and report thereon to the Council by June 30, 1974. Such reports should include an identification of the problem areas and suggestions for revision or clarification of these guidelines to achieve effective coordination of views on environmental aspects (and alternatives, where appropriate) of proposed actions without imposing unproductive administrative procedures. Such reports shall also indicate what progress the agency has made in developing substantial criteria and guidance for making environmental assessments as required by § 1500.6(c) of this directive and by section 102(2)(B) of the Act.

Effective date. The revisions of these guidelines shall apply to all draft and final impact statements filed with the Council after January 28, 1974.

RUSSELL E. TRAIN,
Chairman

APPENDIX I SUMMARY TO ACCOMPANY DRAFT AND FINAL STATEMENTS

(Check one) ( ) Draft. ( ) Final Environmental Statement.

Name of responsible Federal agency (with name of operating division where appropriate). Name, address, and telephone number of individual at the agency who can be contacted for additional information about the proposed action or the statement.

1. Name of action (Check one) ( ) Administrative Action. ( ) Legislative Action.

2. Brief description of action and its purpose. Indicate what States (and counties) particularly affected, and what other proposed Federal actions in the area, if any, are discussed in the statement.

3. Summary of environmental impacts and adverse environmental effects.

4. Summary of major alternatives considered.

5. (For draft statements) List all Federal, State, and local agencies and other parties from which comments have been requested. (For final statements) List all Federal, State, and local agencies and other parties from which written comments have been received.

6. Date draft statement (and final environmental statement, if one has been issued) made available to the Council and the public.

APPENDIX II AREAS OF ENVIRONMENTAL IMPACT AND FEDERAL AGENCIES AND FEDERAL–STATE AGENCIES [1] WITH JURISDICTION BY LAW OR SPECIAL EXPERTISE TO COMMENT THEREON [2]

AIR

Air Quality

Department of Agriculture—
  Forest Service (effects on vegetation)
Atomic Energy Commission (radioactive substances)
Department of Health, Education, and Welfare
Environmental Protection Agency
Department of the Interior—
  Bureau of Mines (fossil and gaseous fuel combustion)
  Bureau of Sport Fisheries and Wildlife (effect on wildlife)
  Bureau of Outdoor Recreation (effects on recreation)
  Bureau of Land Management (public lands)
  Bureau of Indian affairs (Indian lands)
National Aeronautics and Space Administration (remote sensing, aircraft emissions)
Department of Transportation—
  Assistant Secretary for Systems Development and Technology (auto emissions)
  Coast Guard (vessel emissions)
  Federal Aviation Administration (aircraft emissions)

[1] River Basin Commissions (Delaware, Great Lakes, Missouri, New England, Ohio, Pacific Northwest, Souris-Red-Rainy, Susquehanna, Upper Mississippi) and similar Federal-State agencies should be consulted on actions affecting the environment of their specific geographic jurisdictions.

[2] In all cases where a proposed action will have significant international environmental effects, the Department of State should be consulted, and should be sent a copy of any draft and final impact statement which covers such action.

Weather Modification

Department of Agriculture—
  Forest Service
Department of Commerce—
  National Oceanic and Atmospheric Administration
Department of Defense—
  Department of the Air Force
Department of the Interior—
  Bureau of Reclamation
Water Resources Council

WATER

Water Quality

Department of Agriculture—
  Soil Conservation Service
  Forest Service
Atomic Energy Commission (radioactive substances)
Department of the Interior—
  Bureau of Reclamation
  Bureau of Land Management (public lands)
  Bureau of Indian Affairs (Indian lands)
  Bureau of Sport Fisheries and Wildlife
  Bureau of Outdoor Recreation
  Geological Survey
  Office of Saline Water
Environmental Protection Agency
Department of Health, Education, and Welfare
Department of Defense—
  Army Corps of Engineers
  Department of the Navy (ship pollution control)
National Aeronautics and Space Administration (remote sensing)
Department of Transportation—
  Coast Guard (oil spills, ship sanitation)
Department of Commerce—
  National Oceanic and Atmospheric Administration
Water Resources Council
River Basin Commissions (as geographically appropriate)

Marine Pollution, Commercial Fishery Conservation, and Shellfish Sanitation

Department of Commerce—
  National Oceanic and Atmospheric Administration
Department of Defense—
  Army Corps of Engineers
  Office of the Oceanographer of the Navy
Department of Health, Education, and Welfare
Department of the Interior—
  Bureau of Sport Fisheries and Wildlife
  Bureau of Outdoor Recreation
  Bureau of Land Management (outer continental shelf)
  Geological Survey (outer continental shelf)
Department of Transportation—
  Coast Guard
Environmental Protection Agency
National Aeronautics and Space Administration (remote sensing)
Water Resources Council
River Basin Commissions (as geographically appropriate)

Waterway Regulation and Stream Modification

Department of Agriculture—
  Soil Conservation Service
Department of Defense—
  Army Corps of Engineers
Department of the Interior—
  Bureau of Reclamation
  Bureau of Outdoor Recreation
  Fish and Wildlife Service
  Geological Survey
Department of Transportation—
  Coast Guard
Environmental Protection Agency
National Aeronautics and Space Administration (remote sensing)
Water Resources Council
River Basin Commissions (as geographically appropriate)

FISH AND WILDLIFE

Department of Agriculture—
  Forest Service
  Soil Conservation Service
Department of Commerce—
  National Oceanic and Atmospheric Administration (marine species)
Department of the Interior—
  Bureau of Land Management
  Bureau of Outdoor Recreation
  Fish and Wildlife Service
Environmental Protection Agency

SOLID WASTE

Atomic Energy Commission (radioactive waste)
Department of Defense—
  Army Corps of Engineers
Department of Health, Education, and Welfare
Department of the Interior—
  Bureau of Mines (mineral waste, mine acid waste, municipal solid waste, recycling)
  Bureau of Land Management (public lands)
  Bureau of Indian Affairs (Indian lands)
  Geological Survey (geologic and hydrologic effects)
  Office of Saline Water (demineralization)
Department of Transportation—
  Coast Guard (ship sanitation)
Environmental Protection Agency
River Basin Commissions (as geographically appropriate)
Water Resources Council

NOISE

Department of Commerce—
  National Bureau of Standards
Department of Health, Education, and Welfare
Department of Housing and Urban Development (land use and building materials aspects)
Department of Labor—
  Occupational Safety and Health Administration

Department of Transportation—
  Assistant Secretary for Systems Development and Technology
  Federal Aviation Administration, Office of Noise Abatement
Environmental Protection Agency
National Aeronautics and Space Administration

RADIATION

Atomic Energy Commission
Department of Commerce—
  National Bureau of Standards
Department of Health, Education, and Welfare
Department of the Interior—
  Bureau of Mines (uranium mines)
  Mining Enforcement and Safety Administration (uranium mines)
Environmental Protection Agency

HAZARDOUS SUBSTANCES

Toxic Materials

Atomic Energy Commission (radioactive substances)
Department of Agriculture—
  Agricultural Research Service
  Consumer and Marketing Service
Department of Commerce—
  National Oceanic and Atmospheric Administration
Department of Defense
Department of Health, Education, and Welfare
Environmental Protection Agency

Food Additives and Contamination of Foodstuffs

Department of Agriculture—
  Consumer and Marketing Service (meat and poultry products)
Department of Health, Education, and Welfare
Environmental Protection Agency

Pesticides

Department of Agriculture—
  Agricultural Research Service (biological controls, food and fiber production)
  Consumer and Marketing Service
  Forest Service
Department of Commerce—
  National Oceanic and Atmospheric Administration
Department of Health, Education, and Welfare
Department of the Interior—
  Bureau of Sport Fisheries and Wildlife (fish and wildlife effects)
  Bureau of Land Management (public lands)
  Bureau of Indian Affairs (Indian lands)
  Bureau of Reclamation (irrigated lands)
  Fish and Wildlife Service (fish and wildlife effects)
Environmental Protection Agency

Transportation and Handling of Hazardous Materials

Atomic Energy Commission (radioactive substances)
Department of Commerce—
  Maritime Administration
  National Oceanic and Atmospheric Administration (effects on marine life and the coastal zone)

Department of Defense—
  Armed Services Explosive Safety Board
  Army Corps of Engineers (navigable waterways)
Department of Transportation—
  Federal Highway Administration, Bureau of Motor Carrier Safety
  Coast Guard
  Federal Railroad Administration
  Federal Aviation Administration
  Assistant Secretary for Systems Development and Technology
  Office of Hazardous Materials
  Office of Pipeline Safety
Environmental Protection Agency

ENERGY SUPPLY AND NATURAL RESOURCES DEVELOPMENT

Electric Energy Development, Generation, Transmission, and Use

Atomic Energy Commission (nuclear)
Department of Agriculture—
  Rural Electrification Administration (rural areas)
Department of Defense—
  Army Corps of Engineers (hydro)
Department of Health, Education, and Welfare (radiation effects)
Department of Housing and Urban Development (urban areas)
Department of the Interior—
  Bureau of Indian Affairs (Indian lands)
  Bureau of Land Management (public lands)
  Bureau of Reclamation
  Power Marketing Administration
  Geological Survey
  Bureau of Outdoor Recreation
  Fish and Wildlife Service
  National Park Service
Environmental Protection Agency
Federal Power Commission (hydro, transmission, and supply)
River Basin Commissions (as geographically appropriate)
Tennessee Valley Authority
Water Resources Council

Petroleum Development, Extraction, Refining, Transport, and Use

Department of the Interior—
  Office of Oil and Gas
  Bureau of Mines
  Geological Survey
  Bureau of Land Management (public lands and outer continental shelf)
  Bureau of Indian Affairs (Indian lands)
  Fish and Wildlife Service (effects on fish and wildlife)
  Bureau of Outdoor Recreation
  National Park Service
Department of Transportation (Transport and Pipeline Safety)
Environmental Protection Agency
Interstate Commerce Commission

Natural Gas Development, Production, Transmission, and Use

Department of Housing and Urban Development (urban areas)
Department of the Interior—
  Office of Oil and Gas
  Geological Survey

Department of the Interior—Continued
- Bureau of Mines
- Bureau of Land Management (public lands)
- Bureau of Indian Affairs (Indian lands)
- Bureau of Outdoor Recreation
- Fish and Wildlife Service
- National Park Service

Department of Transportation (transport and safety)
Environmental Protection Agency
Federal Power Commission (production, transmission, and supply)
Interstate Commerce Commission

Coal and Minerals Development, Mining, Conversion, Processing, Transport, and Use

Appalachian Regional Commission
Department of Agriculture—
- Forest Service

Department of Commerce
Department of the Interior—
- Office of Coal Research
- Mining Enforcement and Safety Administration
- Bureau of Mines
- Geological Survey
- Bureau of Indian Affairs (Indian lands)
- Bureau of Land Management (public lands)
- Bureau of Outdoor Recreation
- Fish and Wildlife Service
- National Park Service

Department of Labor—
- Occupational Safety and Health Administration

Department of Transportation
Environmental Protection Agency
Interstate Commerce Commission
Tennessee Valley Authority

Renewable Resource Development, Production, Management, Harvest, Transport, and Use

Department of Agriculture—
- Forest Service
- Soil Conservation Service

Department of Commerce
Department of Housing and Urban Development (building materials)
Department of the Interior—
- Geological Survey
- Bureau of Land Management (public lands)
- Bureau of Indian Affairs (Indian lands)
- Bureau of Outdoor Recreation
- Fish and Wildlife Service
- National Park Service

Department of Transportation
Environmental Protection Agency
Interstate Commerce Commission (freight rates)

Energy and Natural Resources Conservation

Department of Agriculture—
- Forest Service
- Soil Conservation Service

Department of Commerce—
  National Bureau of Standards (energy efficiency)
Department of Housing and Urban Development—
  Federal Housing Administration (housing standards)
Department of the Interior—
  Office of Energy Conservation
  Bureau of Mines
  Bureau of Reclamation
  Geological Survey
  Power Marketing Administration
Department of Transportation
Environmental Protection Agency
Federal Power Commission
General Services Administration (design and operation of buildings)
Tennessee Valley Authority

LAND USE AND MANAGEMENT

Land Use Changes, Planning and Regulation of Land Development

Department of Agriculture—
  Forest Service (forest lands)
  Agricultural Research Service (agricultural lands)
Department of Housing and Urban Development
Department of the Interior—
  Office of Land Use and Water Planning
  Bureau of Land Management (public lands)
  Bureau of Indian Affairs (Indian lands)
  Bureau of Sport Fisheries and Wildlife (wildlife refuges)
  Bureau of Outdoor Recreation (recreation lands)
  Fish and Wildlife Service
  National Park Service (NPS units)
Department of Transportation
Environmental Protection Agency (pollution effects)
National Aeronautics and Space Administration (remote sensing)
River Basin Commissions (as geographically appropriate)

Public Land Management

Department of Agriculture—
  Forest Service (forests)
Department of Defense
Department of the Interior—
  Bureau of Land Management
  Bureau of Indian Affairs (Indian lands)
  Bureau of Outdoor Recreation (recreation lands)
  Fish and Wildlife Service (wildlife refuges)
  National Park Service (NPS units)
Federal Power Commission (project lands)
General Services Administration
National Aeronautics and Space Administration (remote sensing)
Tennessee Valley Authority (project lands)

Protection of Environmentally Critical Areas—Floodplains, Wetlands, Beaches and Dunes, Unstable Soils, Steep Slopes, Aquifer Recharge Areas, etc.

Department of Agriculture—
  Agricultural Stabilization and Conservation Service
  Soil Conservation Service
  Forest Service

Department of Commerce—
  National Oceanic and Atmospheric Administration (coastal areas)
Department of Defense—
  Army Corps of Engineers
Department of Housing and Urban Development (urban and floodplain areas)
Department of the Interior—
  Office of Land Use and Water Planning
  Bureau of Outdoor Recreation
  Bureau of Reclamation
  Bureau of Land Management
  Fish and Wildlife Service
  Geological Survey
Environmental Protection Agency (pollution effects)
National Aeronautics and Space Administration (remote sensing)
River Basins Commissions (as geographically appropriate)
Water Resources Council

Land Use in Coastal Areas

Department of Agriculture—
  Forest Service
  Soil Conservation Service (soil stability, hydrology)
Department of Commerce—
  National Oceanic and Atmospheric Administration (impact on marine life and coastal zone management)
Department of Defense—
  Army Corps of Engineers (beaches, dredge and fill permits, Refuse Act permits)
Department of Housing and Urban Development (urban areas)
Department of the Interior—
  Office of Land Use and Water Planning
  Fish and Wildlife Service
  National Park Service
  Geological Survey
  Bureau of Outdoor Recreation
  Bureau of Land Management (public lands)
Department of Transportation—
  Coast Guard (bridges, navigation)
Environmental Protection Agency (pollution effects)
National Aeronautics and Space Administration (remote sensing)

Redevelopment and Construction in Built-Up Areas

Department of Commerce—
  Economic Development Administration (designated areas)
Department of Housing and Urban Development
Department of the Interior—
  Office of Land Use and Water Planning
Department of Transportation
Environmental Protection Agency
General Services Administration
Office of Economic Opportunity

Density and Congestion Mitigation

Department of Health, Education, and Welfare
Department of Housing and Urban Development
Department of the Interior—
  Office of Land Use and Water Planning
  Bureau of Outdoor Recreation
Department of Transportation
Environmental Protection Agency

Neighborhood Character and Continuity

Department of Health, Education, and Welfare
Department of Housing and Urban Development
National Endowment for the Arts
Office of Economic Opportunity

Impacts on Low-Income Populations

Department of Commerce—
  Economic Development Administration (designated areas)
Department of Health, Education, and Welfare
Department of Housing and Urban Development
Office of Economic Opportunity

Historic, Architectural, and Archeological Preservation

Advisory Council on Historic Preservation
Department of Housing and Urban Development
Department of the Interior—
  National Park Service
  Bureau of Land Management (public lands)
  Bureau of Indian Affairs (Indian lands)
General Services Administration
National Endowment for the Arts

Soil and Plant Conservation and Hydrology

Department of Agriculture—
  Soil Conservation Service
  Agricultural Service
  Forest Service
Department of Commerce—
  National Oceanic and Atmospheric Administration
Department of Defense—
  Army Corps of Engineers (dredging, aquatic plants)
Department of Health, Education, and Welfare
Department of the Interior—
  Bureau of Land Management
  Fish and Wildlife Service
  Geological Survey
  Bureau of Reclamation
Environmental Protection Agency
National Aeronautics and Space Administration (remote sensing)
River Basin Commissions (as geographically appropriate)
Water Resources Council

Outdoor Recreation

Department of Agriculture—
  Forest Service
  Soil Conservation Service
Department of Defense—
  Army Corps of Engineers
Department of Housing and Urban Development (urban areas)
Department of the Interior—
  Bureau of Land Management
  National Park Service
  Bureau of Outdoor Recreation
  Bureau of Indian Affairs
  Fish and Wildlife Service
Environmental Protection Agency

National Aeronautics and Space Administration (remote sensing)
River Basin Commissions (as geographically appropriate)
Water Resources Council

APPENDIX III OFFICES WITHIN FEDERAL AGENCIES AND FEDERAL–STATE AGENCIES FOR INFORMATION REGARDING THE AGENCIES' NEPA ACTIVITIES AND FOR RECEIVING OTHER AGENCIES' IMPACT STATEMENTS FOR WHICH COMMENTS ARE REQUESTED

ADVISORY COUNCIL ON HISTORIC PRESERVATION

Office of Review and Compliance, Advisory Council on Historic Preservation, 1522 K Street, N.W., Suite 430, Washington, D.C. 20005 (202) 254–3380

DEPARTMENT OF AGRICULTURE [1]

Office of the Secretary, Attn: Coordinator Environmental Quality Activities, U.S. Department of Agriculture, Washington, D.C. 20250 (202) 447–3965

APPALACHIAN REGIONAL COMMISSION

Office of the Alternate Federal Co-Chairman, Appalachian Regional Commission, 1666 Connecticut Avenue, N.W., Washington, D.C. 20235 (202) 967–4103

DEPARTMENT OF THE ARMY (CORPS OF ENGINEERS)

Executive Director of Civil Works, Office of the Chief of Engineers, U.S. Army Corps of Engineers, Washington, D.C. 20314 (202) 693–7093

DEPARTMENT OF COMMERCE

Office of the Deputy Assistant Secretary for Environmental Affairs, U.S. Department of Commerce, Washington, D.C. 20230 (202) 967–4335

DEPARTMENT OF DEFENSE

Office of the Assistant to the Secretary of Defense for Environmental Quality, U.S. Department of Defense, Room 3D171, The Pentagon, Washington, D.C. 20301 (202) 695–3010

DELAWARE RIVER BASIN COMMISSION

Environmental Unit, Delaware River Basin Commission, Post Office Box 360, Trenton, N.J. 08603 (609) 883–9500

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[1] Requests for comments or information from individual units of the Department of Agriculture, e.g., Soil Conservation Service, Forest Service, etc. should be sent to the Office of the Secretary, Department of Agriculture, at the address given above.

ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

Office of the Assistant Administrator for Environment and Safety, Energy Research and Development Administration, Washington, D.C. 20545 (202) 937–3208

ENVIRONMENTAL PROTECTION AGENCY [2]

Director, Office of Federal Activities, Environmental Protection Agency, 401 M Street, S.W., Washington, D.C. 20460 (202) 755–0777

FEDERAL POWER COMMISSION

Office of Energy Systems, Federal Power Commission, Room 4306, 825 North Capitol Street, N.E., Washington, D.C. 20426 (202) 386–3335

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[2] Contact the Office of Federal Activities for environmental statements concerning legislation, regulations, national program proposals or other major policy issues.

For all other EPA consultation, contact the Regional Administrator in whose area the proposed action (e.g., highway or water resource construction projects) will take place. The Regional Administrators will coordinate the EPA review. Addresses of the Regional Administrators and the areas covered by their regions are as follows:

Regional Administrator I, U.S. Environmental Protection Agency Room 2303, John F. Kennedy Federal Bldg. Boston, Mass. 02203 (617) 223–4635	Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
Regional Administrator II, U.S. Environmental Protection Agency Room 908, 26 Federal Plaza New York, N.Y. 10007 (212) 264–8556	New Jersey, New York, Puerto Rico, Virgin Islands
Regional Administrator III, U.S. Environmental Protection Agency Curtis Bldg., 6th & Walnut Streets Philadelphia, Pa. 19106 (215) 597–8332	Delaware, Maryland, Pennsylvania, Virginia, West Virginia, District of Columbia
Regional Administrator IV, U.S. Environmental Protection Agency 1421 Peachtree Street, N.E. Atlanta, Ga. 30309 (404) 526–5458	Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee
Regional Administrator V, U.S. Environmental Protection Agency 230 South Dearborn Street Chicago, Ill. 60604 (312) 353–5758	Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin

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GENERAL SERVICES ADMINISTRATION

Office of Environmental Affairs, Office of the Deputy Administrator for Special Projects, General Services Administration, Washington, D.C. 20405 (202) 343–4161

GREAT LAKES BASIN COMMISSION

Office of the Chairman, Great Lakes Basin Commission, 3475 Plymouth Road, P.O. Box 999, Ann Arbor, Michigan 48106 (313) 769–7431

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE [3]

Office of Environmental Affairs, Office of the Assistant Secretary for Administration and Management, Department of Health, Education, and Welfare, 330 Independence Avenue, S.W., Washington, D.C. 20201 (202) 245–7243

(Continued)

Regional Administrator VI, U.S. Environmental Protection Agency 1600 Patterson Street Suite 1100 Dallas, Tex. 75201 (214) 749–1237	Arkansas, Louisiana, New Mexico, Texas, Oklahoma
Regional Administrator VII, U.S. Environmental Protection Agency 1735 Baltimore Avenue Kansas City, Mo. 64108 (816) 374–2921	Iowa, Kansas, Missouri, Nebraska
Regional Administrator VIII, U.S. Environmental Protection Agency Suite 900, Lincoln Tower 1860 Lincoln Street Denver, Colo. 80203 (303) 837–4831	Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming
Regional Administrator IX, U.S. Environmental Protection Agency 100 California Street San Francisco, Calif. 94111 (415) 556–0970	Arizona, California, Hawaii, Nevada, American Samoa, Guam, Trust Territories of Pacific Islands, Wake Island
Regional Administrator X, U.S. Environmental Protection Agency 1200 Sixth Avenue Seattle, Wash. 98101 (206) 442–1595	Alaska, Idaho, Oregon, Washington

[3] Contact the Office of Environmental Affairs for information on HEW's environmental statements concerning legislation, regulations, national program proposals or other major policy issues, and for all requests for HEW comments on impact statements of other agencies.

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DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT [4]

Director, Office of Environmental Quality, Department of Housing and Urban Development, Room 7258, Washington, D.C. 20410 (202) 755–6309

(Continued)

For information with respect to HEW actions occurring within the jurisdiction of the Departments' Regional Directors, contact the appropriate Regional Environmental Officer:

Region I:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, John F. Kennedy Center, Room E–311, Boston, Mass. 02203 (617) 223–5485

Region II:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 26 Federal Plaza, Room 3309, New York, N.Y. 10007 (212) 264–4483

Region III:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, P.O. Box 13716, Philadelphia, Pa. 19101 (215) 597–6476

Region IV:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 50 Seventh Street, N.E., Room 447, Atlanta, Ga. 30323 (404) 526–5048

Region V:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 300 South Wacker Drive, 35th floor, Chicago, Ill. 60606 (312) 353–1670

Region VI:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 1114 Commerce Street, Room 925, Dallas, Tex. 75202 (214) 749–7741

Region VII:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 601 East 12th Street, Kansas City, Mo. 64106 (816) 374–5912

Region VIII:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 1916 Stout Street, 10th floor, Denver, Colo. 80202 (303) 837–2875

Region IX:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 50 Fulton Street, Room 410, San Francisco, Calif. 94102 (415) 556–3687

Region X:

Regional Environmental Officer, U.S. Department of Health, Education, and Welfare, 1321 Second Street, Mail Stop 610, Seattle, Wash. 98101 (206) 442–7790

[4] Contact the Director with regard to environmental impacts of legislation, policy statements, program regulations and procedures, and precedent-making project decisions. For all other consultation, contact the HUD Regional Administrator in whose jurisdiction the project lies, as follows:

Regional Administrator I, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, John F. Kennedy Federal Building, Room 405, Boston, Mass. 02203 (617) 223–4347

(Continued)

DEPARTMENT OF THE INTERIOR [5]

Director, Office of Environmental Project Review, Department of the Interior, Interior Building, Washington, D.C. 20240 (202) 343–3891

INTERSTATE COMMERCE COMMISSION

Office of Proceedings, Environmental Section, Interstate Commerce Commission, Washington, D.C. 20423 (202) 343–7966

DEPARTMENT OF LABOR

Office of Manpower for Policy Evaluation and Research, Division of Manpower Policy and Planning, Department of Labor, 601 D Street, N.W., Washington, D.C. 20210 (202) 376–6274

MISSOURI RIVER BASIN COMMISSION

Office of the Chairman, Missouri River Basin Commission, 10050 Regency Circle, Omaha, Nebr. 68114 (402) 397–5714

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Office of Policy Analysis, National Aeronautics and Space Administration, 400 Maryland Avenue, Washington, D.C. 20546 (202) 755–8433

(Continued)

Regional Administrator II, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, 26 Federal Plaza, New York, N.Y. 10007 (212) 264–4197

Regional Administrator III, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pa. 19106 (215) 597–2520

Regional Administrator IV, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, Pershing Point Plaza, 1371 Peachtree Street, N.E., Atlanta, Ga. 30309 (404) 526–3521

Regional Administrator V, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, 300 South Wacker Drive, Chicago, Ill. 60606 (312) 353–1680

Regional Administrator VI, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, U.S. Courthouse, 1100 Commerce Street, Dallas, Tex. 75202 (214) 749–7466

Regional Administrator VII, Environmental Clearance Officer, U.S. Department of Housing nad Urban Development, 911 Walnut Street, Kansas City, Mo. 64106 (816) 374–3191

Regional Administrator VIII, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, 1961 Stout Street, Denver, Colo. 80202 (303) 837–3811

Regional Administrator IX, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, 450 Golden Gate Avenue, P.O. Box 36003, San Francisco, Calif. 94102 (415) 556–5720

Regional Administrator X, Environmental Clearance Officer, U.S. Department of Housing and Urban Development, 1321 Second Avenue, Seattle, Wash. 98101 (206) 442–7790

[5] Requests for comments or information from individual units of the Department of the Interior should be sent to the Office of Environmental Project Review at the address given above.

NATIONAL CAPITAL PLANNING COMMISSION

Office of Environmental Affairs, National Capital Planning Commission, Washington, D.C. 20576 (202) 382–7200

NATIONAL ENDOWMENT FOR THE ARTS

Office of the Director, Architecture and Environmental Arts Program, National Endowment for the Arts, Washington, D.C. 20506 (202) 634–4276

NEW ENGLAND RIVER BASIN COMMISSION

Office of the Chairman, New England River Basin Commission, 55 Court Street, Boston, Mass. 02108 (617) 223–6244

NUCLEAR REGULATORY COMMISSION

For Nuclear Power Plants: Office of the Assistant Director for Environmental Projects, Division of Nuclear Reactor Licensing, Nuclear Regulatory Commission, Washington, D.C. 20555 (202) 443–6965

For Fuel-cycle Projects: Fuel-cycle Environmental Projects Branch, Division of Materials and Fuel-cycle Facility Licensing, Nuclear Regulatory Commission, Washington, D.C. 20555 (202) 492–7631

OHIO RIVER BASIN COMMISSION

Office of the Chairman, Ohio River Basin Commission, 36 East 4th Street, Suite 208, Cincinnati, Ohio 45202 (513) 684–3831

PACIFIC NORTHWEST RIVER BASIN COMMISSION

Office of the Chairman, Pacific Northwest River Basin Commission, Post Office Box 908, Vancouver, Wash. 98660 (206) 694–2581

SOURIS-RED-RAINY RIVER BASINS COMMISSION

Office of the Chairman, Souris-Red-Rainy River Basins Commission, Suite 6, Professional Building, Holiday Mall, Moorhead, Minnesota 56560 (701) 237–5227

DEPARTMENT OF STATE

Office of Environmental Affairs, Room 7822, Department of State, Washington, D.C. 20520 (202) 632–9278

SUSQUEHANNA RIVER BASIN COMMISSION

Office of the Executive Director, Susquehanna River Basin Commission, 5012 Lenker Street, Mechanicsburg, Pa. 17055 (717) 737–0501

TENNESSEE VALLEY AUTHORITY

Office of the Chief of Environmental Assessment and Compliance Staff, Tennessee Valley Authority, 267—401 Building, Chattanooga, Tenn. 37401 (615) 755–3175

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DEPARTMENT OF TRANSPORTATION [6]

Director, Office of Environmental Affairs, Office of the Assistant Secretary for Environment, Safety, and Consumer Affairs, Department of Transportation, Washington, D.C. 20590 (202) 426–4357

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[6] Contact the Office of Environmental Quality, Department of Transportation, for information on DOT's environmental statements concerning legislation, regulations, national program proposals, or other major policy issues.

For information regarding the Department of Transportation's other environmental statements, contact the national office for the appropriate administration:

U.S. Coast Guard

Office of Ports and Waterways Planning, U.S. Coast Guard, 400 Seventh Street, S.W., Washington, D.C. 20590 (202) 426–8722

Federal Aviation Administration

Office of Environmental Quality, Federal Aviation Administration, 800 Independence Avenue, S.W., Washington, D.C. 20591 (202) 426–8722

Federal Highway Administration

Office of Environmental Policy, Environmental Programs Division, Federal Highway Administration, 400 Seventh Street, S.W., Washington, D.C. 20590 (202) 426–0106

Federal Railroad Administration

Office of the Chief Counsel, Federal Railroad Administration, 400 Seventh Street, S.W., Washington, D.C. 20590 (202) 426–0767

Urban Mass Transportation Administration

Capitol Assistance, Urban Mass Transportation Administration, 400 Seventh Street, S.W., Washington, D.C. 20590 (202) 426–1985

For other administrations not listed above, contact the Office of Environmental Quality, Department of Transportation, at the address given above.

For comments on other agencies' environmental statements, contact the appropriate administration's regional office. If more than one administration within the Department of Transportation is to be requested to comment, contact the Secretarial Representative in the appropriate Regional Office for coordination of the Department's comments:

Secretarial Representative

Region I Secretarial Representative, U.S. Department of Transportation, Transportation Systems Center, 55 Broadway, Cambridge, Mass. 02142 (617) 494–2709

Region II Secretarial Representative, U.S. Department of Transportation, 26 Federal Plaza, Room 1811, New York, N.Y. 10007 (212) 264–2672

Region III Secretarial Representative, U.S. Department of Transportation, 434 Walnut Street, 10th floor, Philadelphia, Pa. 19106 (215) 597–9430

Region IV Secretarial Representative, U.S. Department of Transportation, Suite 515, 1720 Peachtree Rd., N.W., Atlanta, Ga. 30309 (404) 526–3738

Region V Secretarial Representative, U.S. Department of Transportation, 17th Floor, 300 S. Wacker Drive, Chicago, Ill. 60606 (312) 353–4000

Region VI Secretarial Representative, U.S. Department of Transportation, 9–C–18 Federal Center, 1100 Commerce Street, Dallas, Tex. 75202 (214) 749–1851

Region VII Secretarial Representative, U.S. Department of Transportation, 601 East 12th Street, Room 634, Kansas City, Mo. 64106 (816) 374–5801

Region VIII Secretarial Representative, U.S. Department of Transportation, Prudential Plaza, Suite 1822, 1050 17th Street, Denver, Colo. 80202 (303) 837–3242

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DEPARTMENT OF THE TREASURY

Office of Assistant Secretary for Administration, Department of the Treasury, Washington, D.C. 20220 (202) 964–5391

(Continued)

Region IX Secretarial Representative, U.S. Department of Transportation, 450 Golden Gate Avenue, Box 36133, San Francisco, Calif. 94102 (415) 556–5961

Region X Secretarial Representative, U.S. Department of Transportation, 3112 Federal Building, 915 Second Street, Seattle, Wash. 98174 (206) 442–0590

Federal Aviation Administration

New England Region, Office of the Regional Director, Federal Aviation Administration, 12 Northeast Executive Park, Burlington, Mass. 01803 (617) 467–7244

Eastern Region, Office of the Regional Director, Federal Aviation Administration, Federal Building, JFK International Airport, Jamaica, N.Y. 11430 (212) 995–3333

Southern Region, Office of the Regional Director, Federal Aviation Administration, P.O. Box 20636, Atlanta, Ga. 30320 (404) 526–7222

Great Lakes Region, Office of the Regional Director, Federal Aviation Administration, 2300 East Devon, Des Plaines, Ill. 60018 (312) 694–4500

Southwest Region, Office of the Regional Director, Federal Aviation Administration, P.O. Box 1689, Fort Worth, Tex. 76101 (817) 624–4911

Central Region, Office of the Regional Director, Federal Aviation Administration, 601 East 12th Street, Kansas City, Mo. 64106 (816) 374–5626

Rocky Mountain Region, Office of the Regional Director, Federal Aviation Administration, Park Hill Station, P.O. Box 7213, Denver, Colo. 80207 (303) 837–3646

Western Region, Office of the Regional Director, Federal Aviation Administration, P.O. Box 92007, Worldway Postal Center, Los Angeles, Calif. 90009 (213) 536–6435

Northwest Region, Office of the Regional Director, Federal Aviation Administration, FAA Building, 9010 East Marginal Way South, King County International Airport, Seattle, Wash. 98108 (206) 767–2780

Federal Highway Administration

Region 1:
Regional Administrator, Federal Highway Administration, 4 Normanskill Boulevard, Delmar, N.Y. 12054 (518) 472–6476

Region 3:
Regional Administrator, Federal Highway Administration, George H. Fallon Federal Office Building, Room 1633, 31 Hopkins Plaza, Baltimore, Md. 21201 (301) 962–2361

Region 4:
Regional Administrator, Federal Highway Administration, 1720 Peachtree Road, N.W., Suite 200, Atlanta, Ga. 30309 (404) 526–5078

Region 5:
Regional Administrator, Federal Highway Administration, 18209 Dixie Highway, Homewood, Ill. 60430 (312) 799–6300

Region 6:
Regional Administrator, Federal Highway Administration, 819 Taylor Street, Fort Worth, Tex. 76102 (817) 334–3232

Region 7:
Regional Administrator, Federal Highway Administration, P.O. Box 7186, Country Club Station, Kansas City, Mo. 64113 (816) 926–7563

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UPPER MISSISSIPPI RIVER BASIN COMMISSION

Office of the Chairman, Upper Mississippi River Basin Commission, Federal Office Building, Room 510, Fort Snelling, Twin Cities, Minn. 55111 (612) 725–4690

WATER RESOURCES COUNCIL

Office of the Assistant Director, Planning Division, Water Resources Council, 2120 L Street, N.W., Suite 800, Washington, D.C. 20037 (202) 254–6442

(Continued)

Region 8:
Regional Administrator, Federal Highway Administration, Building 40, Room 242, Denver Federal Center, Denver, Colo. 80225 (303) 236–4051

Region 9:
Regional Administrator, Federal Highway Administration, 450 Golden Gate Avenue, Box 36112, San Francisco, Calif. 94102 (415) 556–6415

Region 10:
Regional Administrator, Federal Highway Administration, Mohawk Building, Room 412, 222 Southwest Morrison Street, Portland, Oreg. 97204 (503) 221–2065

Urban Mass Transportation Administration

Region I, Office of the UMTA Representative, Urban Mass Transportation Administration, Transportation Systems, Kendall Square, Cambridge, Mass. 02142 (617) 494–2005

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APPENDIX IV STATE AND LOCAL AGENCY REVIEW OF IMPACT STATEMENTS

1. OMB Circular No. A–95 through its system of clearinghouses provides a means for securing the views of State and local environmental agencies, which can assist in the preparation of impact statements. Under A–95, review of the proposed project in the case of federally assisted projects (Part I of A–95) generally takes place prior to the preparation of the impact statement. Therefore, comments on the environmental effects of the proposed project that are secured during this stage of the A–95 process represent inputs to the environmental impact statement.

2. In the case of direct Federal development (Part II of A–95), Federal agencies are required to consult with clearinghouses at the earliest practicable time in the planning of the project or activity. Where such consultation occurs prior to completion of the draft impact statement, comments relating to the environmental effects of the proposed action would also represent inputs to the environmental impact statement.

3. In either case, whatever comments are made on environmental effects of proposed Federal or federally assisted projects by clearinghouses, or by State and local environmental agencies through clearinghouses, in the course of the A–95 review should be attached to the draft impact statement when it is circulated for review. Copies of the statement should be sent to the agencies making such comments. Whether those agencies then elect to comment again on the basis of the draft impact statement is a matter to be left to the discretion of the commenting agency depending on its resources, the significance of the project, and the extent to which its earlier comments were considered in preparing the draft statement.

4. The clearinghouses may also be used, by mutual agreement, for securing reviews of the draft environmental impact statement. However, the Federal agency may wish to deal directly with appropriate State or local agencies in the review of impact statements because the clearinghouses may be unwilling or unable to handle this phase of the process. In some cases, the Governor may have designated a specific agency, other than the clearinghouse, for securing reviews of impact statements. In any case, the clearinghouses should be sent copies of the impact statement.

5. To aid clearinghouses in coordinating State and local comments, draft statements should include copies of State and local agency comments made earlier under the A–95 process and should indicate on the summary sheet those other agencies from which comments have been requested, as specified in Appendix I of the CEQ Guidelines.

APPENDIX D

PROPOSED NEPA REGULATIONS*

May 31, 1978

AGENCY

Council on Environmental Quality, Executive Office of the President.

ACTION

Proposed regulations.

SUMMARY

These proposed regulations implementing procedural provisions of the National Environmental Policy Act are submitted for public comment. These regulations would provide Federal agencies with uniform procedures for implementing the law. The regulations would accomplish three principal aims: to reduce paperwork, to reduce delays, and to produce better decisions.

DATES

Comments must be received by August 11, 1978.

ADDRESSES

Comments should be addressed to: Nicholas C. Yost, General Counsel, Attention: NEPA Comments, Council on Environmental Quality, 722 Jackson Place N.W., Washington, D.C. 20006.

FOR FURTHER INFORMATION CONTACT

Nicholas C. Yost, General Counsel on Environmental Quality (address same as above), 202–633–7032.

SUPPLEMENTARY INFORMATION

1. PURPOSE

We are publishing for public review draft regulations to implement the National Environmental Policy Act. Their purpose is to provide all Federal agencies with an efficient, uniform procedure for translating the law into practical action. We expect the new regulations to accomplish three principal aims: To reduce paperwork, to reduce delays, and at the same time to produce better decisions, thereby better accomplishing the law's objective, which is to protect and enhance the quality of the human environment.

These regulations replace the Guidelines issued by previous Councils, under Executive Order 11514 (1970), and apply more broadly. The Guidelines assist Federal agencies in carrying out NEPA's most conspicuous requirement, the preparation of environmental impact statements (EISs). These regulations were developed in response to Executive Order 11991

* 43 Fed. Reg. 25230–47 (1978).

issued by President Carter in 1977, and implement "the procedural provisions of the Act." They address all nine subdivisions of Section 102(2) of the Act, rather than just the EIS provision covered by the Guidelines, and they carry out the broad purposes and spirit of the Act.

President Carter instructed us that the regulations should be:

* * * designed to make the environmental impact statement more useful to decision-makers and the public; and to reduce paperwork and the accumulation of extraneous background data, in order to emphasize the need to focus on real environmental issues and alternatives.

The President has also signed Executive Order 12044, dealing with regulatory reform. It is our intention that that Order and these NEPA regulations be read together and implemented consistently.

2. SUMMARY OF CHANGES MADE BY THE REGULATIONS

Following this mandate in developing the new regulations, we have kept in mind the threefold objective of less paperwork, less delay, and better decisions.

A. Reducing Paperwork

The measures to reduce paperwork are listed in sec. 1500.4 of the regulations. Neither NEPA nor these regulations impose paperwork requirements on the public. These regulations reduce such requirements on agencies of government.

i. *Reducing the length of environmental impact statements* Agencies are directed to write concise EISs, which shall normally be less than 150 pages, or, for proposals of unusual scope and complexity, 300 pages.

ii. *Emphasize options among alternatives* The regulations stress that the environmental analysis is to concentrate on alternatives, which are the heart of the matter; to treat peripheral matters briefly; and to avoid accumulating masses of background data which tend to obscure the important issues.

iii. *Using an early "scoping" process to determine what the important issues are* To assist agencies in deciding what the central issues are, how long the EIS shall be, and how the responsibility for the EIS will be allocated among the lead agency and cooperating agencies, a new "scoping" procedure is established. Scoping meetings are to be held as early in the NEPA process as possible—in most cases, shortly after the decision to prepare an EIS—and shall be integrated with other planning.

iv. *Writing in plain language* The regulations strongly advocate writing in plain, direct language.

v. *Following a clear format* The regulations spell out a standard format intended to eliminate repetitive discussion, stress the major conclusions, highlight the areas of controversy, and focus on the issues to be resolved.

vi. *Requiring summaries of environmental impact statements* To make the document more usable by more people.

vii. *Eliminating duplication* To eliminate duplication, the regulations provide for Federal agencies to prepare EISs jointly with state and local units of government which have "little NEPA" requirements. They also permit a Federal agency to adopt another agency's EIS.

vii. *Consistent terminology* The regulations provide a uniform terminology for the implementation of NEPA. For instance, the CEQ requirement for an environmental assessment will replace the following (nonexhaustive) list of comparable existing agency procedures: "survey" (Corps of Engineers), "environmental analysis" (Forest Service), "initial assessment" (Transportation), "normal or special clearance" (HUD), "environmental analysis report" (Interior), and "marginal impact statement" (HEW).

ix. *Reducing paperwork requirements* The regulations will reduce reporting paperwork requirements as summarized below. The existing Guidelines issued under Executive Order 11514 cover section 102(2)(C) of

NEPA (environmental impact statements), and the new CEQ regulations cover sections 102(2)(A) through (I). The regulations replace not only the requirements of the Guidelines concerning environmental impact statements, but also replace more than 70 different sets of existing agency regulations, although each agency will issue its own implementing procedures to explain how these regulations apply to its particular programs.

Existing Requirements (Applicable Guidelines *sections are noted.*)	New Requirements (Applicable regulations *sections are noted.*)
Assessment (optional under Guidelines on a case-by-case basis; currently required, however by most major agencies in practice or in procedures) 1500.6.	*Assessment* (limited requirement: not required where there would not be environmental effects or where an EIS would normally be required) 1501.3, .4.
Notice of intent to prepare impact statement 1500.6.	*Notice of intent* to prepare EIS and commence scoping process 1501.7.
Quarterly list of notices of intent 1500.6.	Requirement abolished.
Negative determination (decision not to prepare impact, statement) 1500.6.	*Finding of no significant impact* 1501.4.
Quarterly list of negative determination 1500.6.	Requirement abolished.
Draft EIS 1500.7 ----------	*Draft EIS* 1502.9
Final EIS 1500.6, .10 ----------	*Final EIS* 1502.9
EISs on legislative reports ("agency reports on legislation initiated elsewhere") 1500.5(a)(1).	Requirement abolished.
Agency report to CEQ on implementation experience 1500.14(b).	Do.

Existing Requirements (Applicable Guidelines *sections are noted.*)	New Requirements (Applicable regulations *sections are noted.*)
Agency report to CEQ on substantive guidance 1500.6(c), .14.	Do.
Record of decision (no Guideline provision but required by many agencies' own procedures and in a wide range of cases generally under the Administrative Procedure Act and OMB Circular A-95, Part I, sec. 6(c) and (d), Part II, sec. 5(b)(4)).	*Record of decision* (brief explanation of decision when an EIS has been prepared; no circulation requirement) 1505.2.

B. Reducing Delay

The measures to reduce delay are listed in § 1500.5 of the regulations.

i. *Time limits on the NEPA process* The regulations encourage lead agencies to set time limits on the NEPA process and require that they be set when requested by an applicant.

ii. *Integrating EIS requirements with other environmental review requirements* Often the NEPA process and the requirements of other laws proceed separately, causing delay. The regulations provide for all agencies with jurisdiction over the project to cooperate so that all reviews may be conducted simultaneously.

iii. *Integrating the NEPA process into early planning* If environmental review is tacked on to the end of the planning process, then the process is prolonged, or else the EIS is written to justify a decision that has already been made, and genuine consideration may not be given to environmental factors.

iv. *Emphasizing interagency cooperation before the EIS is drafted* The regulations emphasize that other agencies should begin cooperating with the lead agency before the EIS is prepared in order to encourage early resolution of differences. By having the affected agencies cooperate early in preparing a draft EIS, we hope both to produce a better draft and to reduce delays caused by unnecessarily late criticism.

v. *Swift and fair resolution of lead agency disputes* When agencies differ as to who shall take the lead in preparing an EIS or none is willing to take the lead, the regulations provide a means for prompt resolution of the dispute.

vi. *Prepare EISs on programs and not repeat the same material in project specific EISs* Material common to many actions may be covered in a broad EIS, and then through "tiering" may be incorporated by reference rather than reiterated in each subsequent EIS.

vii. *Legal delays* The regulations provide that litigation should come at the end rather than in the middle of the process.

viii. *Accelerated procedures for legislative proposals* The regulations provide accelerated simplified procedures for environmental analysis of legislative proposals, to fit better with Congressional schedules.

C. Better Decisions

Most of the features described above will help to improve decisionmaking. This, of course, is the fundamental purpose of the NEPA process, the end to which the EIS is a means. Section 101 of NEPA sets forth the substantive requirements of the Act, the policy to be implemented by the "action-forcing" procedures of Section 102. These procedures must be tied to their intended purpose, otherwise they are indeed useless paper work and wasted time. A central purpose of these regulations is to tie means to ends.

i. *Securing more accurate, professional documents* The regulations insist upon accurate documents as the basis for sound decisions. The documents should draw upon all the appropriate disciplines from the natural and social sciences, plus the environmental design arts. The lead agency is responsible for the professional integrity of reports, and care should be taken to keep any possible bias from data prepared by applicants out of the environmental analysis. A list of people who helped prepare documents, and their professional qualifications, should be included in the EIS.

ii. *Recording in the decision how the EIS was used* The new regulations require agencies to point out in the EIS analysis of alternatives which one is preferable on environmental grounds—including the often-overlooked alternative of no action at all. (However, if "no action" is identified as environmentally preferable, a second-best alternative must also be pointed out.)

Agencies must also produce a concise public record, indicating how the EIS was used in arriving at the decision. If the EIS is disregarded, it really is useless paperwork, It only contributes if it is used by the decisionmaker and the public. The record must state what the final decision was; whether

the environmentally preferable alternative was selected; and if not, what considerations of national policy led to another choice.

iii. *Insure follow-up of agency decisions* When an agency requires environmentally protective mitigation measures in its decision, the regulations provide for means to ensure that these measures are monitored and implemented.

Taken altogether, the regulations aim for a streamlined process, but one which has a broader purpose than the Guidelines they replace. The Guidelines emphasized a single document, the EIS, while the regulations emphasize the entire NEPA process, from early planning through assessment and EIS preparation through provisions for follow-up. They attempt to gear means to ends—to insure that the action-forcing procedures of sec. 102(2) of NEPA are used by agencies to fulfill the requirements of the Congressionally mandated policy set out in sec. 101 of the Act. Furthermore, the regulations are uniform, applying in the same way to all federal agencies, although each agency will develop its own procedures for implementing the regulations. Our attempt has been with these new regulations to carry out as faithfully as possible the original intent of Congress in enacting NEPA.

3. BACKGROUND

We have been greatly assisted in our task by the hundreds of people who responded to our call for suggestions on how to make the NEPA process work better. In public hearings which we held in June 1977, we invited testimony from a broad array of public officials, organizations, and private citizens, affirmatively involving NEPA's critics as well as its friends.

Among those represented were the U.S. Chamber of Commerce, which coordinated testimony from business; the Building and Construction Trades Department of the AFL-CIO, for labor; the National Conference of State Legislatures, for state and local governments; the Natural Resources Defense Council, for environmental groups. Scientists, scholars, and the general public were there.

There was extraordinary consensus among these diverse witnesses. All, without exception, expressed the view that NEPA benefited the public. Equally widely shared was the view that the process had become needlessly cumbersome and should be trimmed down. Witness after witness said that the length and detail of EIS's made it extremely difficult to distinguish the important from the trivial. The degree of unanimity about the good and bad points of the NEPA process was such that at one point an official spokesman for the oil industry rose to say that he adopted in its entirety the presentation of the President of the Sierra Club.

After the hearings we culled the record to organize both the problems and the solutions proposed by witnesses into a 38-page "NEPA Hearing Questionnaire." The questionnaire was sent to all witnesses, every state governor, all federal agencies, and everyone who responded to an invitation in the *Federal Register*. We received more than 300 replies, from a broad cross section of groups and individuals. By the comments we received from respondents we gauged our success in faithfully presenting the results of the public hearings. One commenter, an electric utility official, said that for the first time in his life he knew the government was listening to him, because all the suggestions made at the hearing turned up in the questionnaire. We then collated all the responses for use in drafting the regulations.

We also met with every agency of the federal government to discuss what should be in the regulations. Guided by these extensive interactions with government agencies and the public, we prepared draft regulations which were circulated for comment to all federal agencies in December 1977. We then studied agency comments in detail, and consulted numerous federal officials with special experience in implementing the Act. Informal redrafts were circulated to the agencies with greatest experience in preparing

environmental impact statements. Improvements from our December 12 draft reflect this process.

At the same time that federal agencies were reviewing the early draft, we continued to meet with, listen to, and brief members of the public, including representatives of business, labor, state and local governments, environmental groups and others. We also considered seriously and proposd in our regulations virtually every major recommendation made by the Commission on Federal Paperwork and the General Accounting Office in their recent studies on the environmental impact statement process. The studies by these two independent bodies were among the most detailed and informed reviews of the paperwork abuses of the impact statement process. In many cases, such as streamlining intergovernmental coordination, the proposed regulations go further than their recommendations.

4. EXCLUSION

It should be noted that the issue of application of NEPA to environmental effects occurring outside the United States is the subject of continued discussions within the government and is not addressed in these regulations. Affected agencies continue to hold different views on this issue. Nothing in these regulations should be construed as asserting that NEPA either does or does not apply in this situation.

5. ANALYSIS AND ASSESSMENT OF THE REGULATIONS

Since Executive Order 12044 became effective on March 23, 1978, after the Council's draft NEPA regulations had completed interagency review, the extent to which Executive Order 12044 applies to the Council's nearly completed process of developing NEPA regulations is not clear. Nevertheless, the requirements of Executive Order 12044 have been undertaken to the fullest extent possible. The analyses required by sections 2(b), (c), (d), and 3(b), to the extent they may apply to the Council's proposed NEPA regulations, are available on request.

The Council has prepared a special environmental assessment of these regulations to illustrate the analysis that is appropriate under NEPA. The assessment discusses alternative regulatory approaches. Some regulations lend themselves to an analysis of their environmental impacts, particularly regulations with substantive requirements of those which apply to a physical setting. Although the Council obviously believes that its regulations will work to improve environmental quality, the impacts of procedural regulations of this kind are not susceptible to detailed analysis beyond that set out in the assessment.

Both the analyses under Executive Order 12044 and the assessment described above are available on request. Comments may be made on both documents in the same manner and by the same time as the comments on the regulations.

6. ADDITIONAL SUBJECTS FOR COMMENTS

Several issues have been brought to our attention as appropriate subjects to be covered in the regulations. They are difficult issues on which we particularly solicit thoughtful views.

a. *Data bank* Many were intrigued by the idea of a national data bank in which information developed in one EIS would be stored and become available for use in a subsequent EIS. Public comment on the questionnaire led us to conclude, reluctantly, that the idea is impractical. In practice most environmental information is specific to given areas or activities. To assemble a nationwide data bank would demand financial and other resources that are simply beyond the benefits that may be achieved. We have not included a data bank in these regulations but have instead tried to insure that in the scoping process the preparers of one EIS become aware

of all related EISs so they can make use of the information in them. We would however, welcome comment on this subject.

b. *Encouragement for agencies to fund public comments on EISs when an important viewpoint would otherwise not be presented* The Council has been urged to provide either encouragement or direction to agencies, as part of their routine EIS preparation, to provide funds to responsible groups for public comments when important viewpoints would not otherwise be presented. Although we are acutely aware of the importance of comments to the success of the EIS process, we have not included such a provision. We would welcome comment on this subject also.

CONCLUSION

We look forward to your comments and help. To repeat, comments should be sent by August 11, 1978, to Nicholas C. Yost, General Counsel, Attention: NEPA Comments, Council on Environmental Quality, 722 Jackson Place NW., Washington, D.C. 20006.

Thank you for cooperating with us.

CHARLES WARREN,
Chairman.

Title 40 Chapter V is proposed to be amended by revising Part 1500 and by adding Parts 1501 through 1508 to read as follows:

PART 1500—PURPOSE, POLICY, AND MANDATE

Sec.
1500.1 Purpose
1500.2 Policy
1500.3 Mandate
1500.4 Reducing paperwork
1500.5 Reducing delay
1500.6 Agency authority

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970 as amended by Executive Order 11991, May 24, 1977).

§ 1500.1 PURPOSE

(a) The National Environmental Policy Act (NEPA) is our basic national charter for protection of the environment. It establishes policy, sets goals (section 101), and provides means (section 102) for carrying out the policy. Section 102(2) contains "action-forcing" provisions to make sure that federal agencies act according to the letter and spirit of the Act. The regulations that follow implement Section 102(2). Their purpose is to tell federal agencies what they must do to comply with the procedures and achieve the goals of the Act. The President, the federal agencies, and the courts share responsibility for enforcing the Act so as to achieve the substantive requirements of section 101.

(b) NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA. Most important, NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.

(c) Ultimately, of course, it is not better documents but better decisions that count. NEPA's purpose is not to generate paperwork—even excellent paperwork—but to foster excellent action. The NEPA process is intended to help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment. These regulations provide the direction to achieve this purpose.

§ 1500.2 POLICY

Federal agencies shall to the fullest extent possible:

(a) Interpret and administer the policies, regulations, and public laws of the United States in accordance with the policies set forth in the Act and in these regulations.

(b) Implement procedures to make the NEPA process more useful to decisionmakers and the public; to reduce paperwork and the accumulation of extraneous background data; and to emphasize real environmental issues and alternatives. Environmental impact statements shall be concise, clear, and to the point, and shall be supported by evidence that agencies have made the necessary environmental analyses.

(c) Integrate the requirements of NEPA with other planning and environmental review procedures required by law or by agency practice so that all such procedures run concurrently, rather than consecutively.

(d) Encourage and facilitate public involvement in decisions which affect the quality of the human environment.

(e) Use the NEPA process to identify and assess the reasonable alternatives to proposed actions that will avoid or minimize adverse effects of these actions upon the quality of the human environment.

(f) Use all practicable means, consistent with the requirements of the Act and other essential considerations of national policy, to restore and enhance the quality of the human environment and avoid or minimize any possible adverse effects of their actions upon the quality of the human environment.

§ 1500.3 MANDATE

Parts 1500–1508 of this Title provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of the National Environmental Policy Act of 1969, as amended (Pub. L. 91–190, 42 U.S.C. 4321 et seq.) (NEPA or the Act) except where compliance would be inconsistent with other statutory requirements. These regulations are issued pursuant to NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977). These regulations, unlike the predecessor guidelines, are not confined to Sec. 102(2)(C) (environmental impact statements). The regulations apply to the whole of section 102(2). The provisions of the Act and of these regulations must be read together as a whole in order to comply with the spirit and letter of the law. It is the Council's intention that judicial review of agency compliance with these regulations not occur before an agency has filed the final environmental impact statement, or has made a finding of no significant impact, or takes action that will result in irreparable injury.

§ 1500.4 REDUCING PAPERWORK

Agencies shall reduce excess paperwork by:

(a) Reducing the length of environmental impact statements (§ 1502.2 (c)), by means such as setting appropriate page limits (§ 1501.7(b)(1) and 1502.7).

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(b) Preparing analytic rather than encyclopedic environmental impact statements (§ 1502.2(a)).

(c) Discussing only briefly issues other than significant ones (§ 1502.2 (b)).

(d) Writing environmental impact statements in plain language (§ 1502.8).

(e) Following a clear format for environmental impact statements

(f) Emphasizing the portions of the environmental impact statement that are useful to decisionmakers and the public (§§ 1502.14 and 1502.15) and reducing emphasis on background material (§ 1502.16).

(g) Using the scoping process not only to identify significant environmental issues deserving of study, but also to deemphasize insignificant issues, narrowing the scope of the environmental impact statement process accordingly (§ 1501.7).

(h) Summarizing the environmental impact statement (§ 1502.12) and circulating the summary instead of the entire environmental impact statement if the latter is unusually long (§ 1502.19).

(i) Using program, policy, or plan environmental impact statements and tiering from statements of broad scope to those of narrower scope to eliminate repetitive discussions of the same issues (§§ 1502.4 and 1502.20).

(j) Incorporating by reference (§ 1502.21).

(k) Integrating NEPA requirements with other environmental review and consultation requirements (§ 1502.25).

(l) Requiring comments to be as specific as possible (§ 1503.3).

(m) Attaching and circulating only changes to the draft environmental impact statement, rather than rewriting and circulating the entire statement when changes are minor (§ 1503.4(b)).

(n) Eliminating duplication with State and local procedures by providing for joint preparation (§ 1506.2) and with other Federal procedures by providing for one agency's adoption of appropriate environmental documents prepared by another agency (§ 1506.3).

(o) Combining environmental documents with other documents (§ 1506.4).

(p) Using categorical exclusions to exclude from environmental impact statement requirements categories of actions which do not individually or cumulatively have a significant effect on the human environment (§ 1508.4).

(q) Using a finding of no significant impact and not preparing an environmental impact statement when an action not otherwise excluded will not have a significant effect on the human environment (§ 1508.13).

§ 1500.5 REDUCING DELAY

Agencies shall reduce delay by:

(a) Integrating the NEPA process into early planning (§ 1501.2).

(b) Emphasizing interagency cooperation before the environmental impact statement is prepared rather than adversary comments on a completed document (§ 1501.6).

(c) Insuring the swift and fair resolution of lead agency disputes (§ 1501.5).

(d) Using the scoping process for an early identification of what are and what are not the real issues (§ 1501.7).

(e) Establishing appropriate time limits for the environmental impact statement process (§§ 1501.7(b)(2) and 1501.8).

(f) Preparing environmental impact statements early in the process (§ 1502.5).

(g) Integrating NEPA requirements with other environmental review and consultation requirements (§ 1502.25).

(h) Eliminating duplication with State and local procedures by providing for joint preparation (§ 1506.2) and with other Federal procedures by

providing for one agency's adoption of appropriate environmental documents prepared by another agency (§ 1506.3).

(i) Combining environmental documents with other documents (§ 1506.4).

(j) Using accelerated procedures for proposals for legislation (§ 1506.8).

(k) Using categorical exclusions to exclude from environmental impact statement requirements categories of actions which do not individually or cumulatively have a significant effect on the human environment (§ 1508.4).

(l) Using a finding of no significant impact and not preparing an environmental impact statement when an action not otherwise excluded will not have a significant effect on the human environment (§ 1508.13).

§ 1500.6 AGENCY AUTHORITY

Each agency shall interpret the provisions of the Act as a supplement to its existing authority and as a mandate to view traditional policies and missions in the light of the Act's national environmental objectives. Agencies shall review their policies, procedures, and regulations accordingly and revise them as necessary to ensure full compliance with the purposes and provisions of the Act. The phrase "to the fullest extent possible" in section 102 means that each agency of the Federal Government shall comply with that section unless existing law applicable to the agency's operations expressly prohibits or makes compliance impossible.

PART 1501—NEPA AND AGENCY PLANNING

Sec.

1501.1 Purpose
1501.2 Apply NEPA early in process
1501.3 When to prepare an environmental assessment
1501.4 Whether to prepare an environmental impact statement
1501.5 Lead agencies
1501.6 Cooperating agencies
1501.7 Scoping
1501.8 Time limits

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by the Executive Order 11991, May 24, 1977).

§ 1501.1 PURPOSE

The purposes of this part include:

(a) Integrating the NEPA process into early planning to insure appropriate consideration of NEPA's policies and to eliminate delay.

(b) Emphasizing cooperative consultation among agencies before the environmental impact statement is prepared rather than adversary comments on a completed document.

(c) Providing for the swift and fair resolution of lead agency disputes.

(d) Identifying at an early stage the significant environmental issues deserving of study and demphasizing insignificant issues, narrowing the scope of the environmental impact statement accordingly.

(e) Providing a mechanism for putting appropriate time limits on the environmental impact statement process.

§ 1501.2 APPLY NEPA EARLY IN PROCESS

Agencies shall integrate the NEPA process with other planning at the earliest possible time to insure that planning and decisions reflect environ-

mental values, to avoid delays later in the process, and to head off potential conflicts. Each agency shall:

(a) As specified by § 1507.2 comply with the mandate of sec. 102(2)(A) to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on man's environment."

(b) Identify environmental effects and values in adequate detail so they can be compared to economic and technical analyses. Environmental documents and appropriate analyses shall be circulated and reviewed at the same time as other planning documents.

(c) Study, develop, and describe appropriate alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources as provided by sec. 102(2)(E) of the Act.

(d) Provide for cases where actions are planned by other than Federal agencies before Federal involvement so that:

(1) The sponsor of the proposal initiates studies if Federal involvement is foreseeable.

(2) The Federal agency consults early with appropriate State and local agencies and with interested private persons and organizations when its own involvement is reasonably foreseeable.

(3) The Federal agency commences its NEPA process at the earliest possible time.

§ 1501.3 WHEN TO PREPARE AN ENVIRONMENTAL ASSESSMENT

An environmental assessment (§ 1508.9) shall be prepared unless one is not necessary under the procedures adopted under § 1507.3(b). Agencies may prepare an assessment on any action at any time in order to assist agency planning and decisionmaking.

§ 1501.4 WHETHER TO PREPARE AN ENVIRONMENTAL IMPACT STATEMENT

In determining whether to prepare an environmental impact statement the Federal agency shall:

(a) Determine under § 1507.3 whether the proposal is one which

(1) Normally requires an environmental impact statement, or

(2) Normally does not require either an environmental impact statement or an environmental assessment (categorical exclusion).

(b) If the proposed action is not covered by paragraph (a), prepare an environmental assessment (§ 1508.9). The agency shall involve environmental agencies and the public, to the extent practicable, in preparing the assessment.

(c) Based on the environmental assessment make its determination whether to prepare an environmental impact statement.

(d) If the agency will prepare an environmental impact statement, the agency shall commence the scoping process (§ 1501.7).

(e) If the agency determines on the basis of the environmental assessment not to prepare a statement, the agency shall prepare a finding of no significant impact (§ 1508.13).

(1) The agency shall make the finding of no significant impact available in a manner calculated to inform the affected public as specified in § 1506.6.

(2) In certain limited circumstances the agency shall make the finding of no significant impact available for public review for 30 days before the agency makes its final determination whether to prepare an environmental impact statement and before the action may begin. The circumstances are:

(i) The proposed action is, or is closely similar to, one which normally requires the preparation of an environmental impact statement under the

procedures adopted by the agency pursuant to section 1507.3(b), or

(ii) The nature of the proposed action is one without precedent.

§ 1501.5 LEAD AGENCIES

(a) A lead agency shall supervise the preparation of an environmental impact statement if more than one Federal agency either:

(1) Proposes or is involved in the same action; or

(2) Is involved in a group of actions directly related to each other because of their functional interdependence or geographical proximity.

(b) More than one Federal, State, or local agency, one of which must be Federal, may act as joint lead agencies to prepare an environmental impact statement (section 1506.2).

(c) If an action satisfies the provisions of paragraph (a) of this section the potential lead agencies concerned shall determine by letter or memorandum which agency shall be the lead agency and which shall be cooperating agencies. The agencies shall resolve the lead agency question in a manner that will not cause delay. If there is disagreement among the agencies, the following factors (which are listed in descending importance) shall determine lead agency designation:

(1) Magnitude of agency's involvement.

(2) Project approval/disapproval authority.

(3) Expertise concerning the action's environmental effects.

(4) Duration of agency's involvement.

(5) Sequence of agency's involvement.

(d) If potential lead agencies fail to agree on which agency shall be the lead agency as specified in paragraph (c) of this section, (1) any Federal agency or (2) any State or local agency or private person substantially affected by the absence of agreement on lead agency designation may make a written request to the potential lead agencies that a lead agency be designated.

(e) If Federal agencies are unable to agree on which agency will be the lead agency or if the procedure described in paragraph (d) of this section has not resulted within a reasonable time in a lead agency designation, any of the agencies or persons concerned may file a request with the Council asking it to determine which Federal agency shall be the lead agency.

A copy of the request shall be transmitted to each potential lead agency. The request shall consist of:

(1) A precise description of the nature and extent of the proposed action;

(2) A detailed statement of why each potential lead agency should or should not be the lead agency under the criteria specified in subparagraph (2).

(f) A response may be filed by any potential lead agency concerned within 20 days after a request is filed with the Council. The Council shall determine within 20 days after receiving the request and all responses which Federal agency shall be the lead agency and the extent to which the other Federal agencies concerned shall be cooperating Federal agencies.

§ 1501.6 COOPERATING AGENCIES

Th purpose of this section is to emphasize agency cooperation early in the NEPA process. Upon request of the lead agency, any other Federal agency which has jurisdiction by law shall be a cooperating agency. In addition any other Federal agency which has special expertise with respect to any environmental issue, which should be addressed in the statement may be a cooperating agency upon request of the lead agency.

(a) The lead agency shall:

(1) Request the participation of each cooperating agency in the NEPA process at the earliest possible time.

(2) To the maximum extent possible consistent with its responsibility as lead agency use the environmental analysis and proposals of cooperating agencies with jurisdiction by law or special expertise.

(3) Meet with a cooperating agency at the latter's request.

(b) Each cooperating agency shall:

(1) Participate in the NEPA process at the earliest possible time.

(2) Participate in the scoping process.

(3) Assume on request of the lead agency responsibility for developing information and preparing environmental analyses including portions of the environmental impact statement concerning which the cooperating agency has special expertise.

(4) Make available staff support at the lead agency's request to enhance the latter's interdisciplinary capability.

(5) Normally a cooperating agency shall use its own funds. The lead agency shall, to the extent available funds permit, fund those major activities or analyses it requests from cooperating agencies. Potential lead agencies shall include such funding requirements in their budget requests.

§ 1501.7 SCOPING

There shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues. This process shall be termed scoping. As soon as practicable after its decision to prepare an environmental impact statement and before the scoping process the lead agency shall publish a notice of intent (§ 1508.21) in the *Federal Register*.

(a) As part of the scoping process the lead agency shall:

(1) Invite the participation of affected Federal, State, and local agencies, any affected Indian tribe, the proponent of the action, and other interested persons (including those who might not be in accord with the action).

(2) Determine the scope (§ 1508.24) and the significant issues to be analyzed in depth in the environmental impact statement.

(3) Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (§ 1506.3), narrowing the discussion of these issues in the statement to a brief presentation of why they will not have a significant effect on the human environment or a reference to their coverage elsewhere.

(4) Allocate assignments for preparation of the environmental impact statement among the lead and cooperating agencies, with the lead agency retaining responsibility for the statement.

(5) Indicate any environmental assessments and other environmental impacts statements which are being or will be prepared that are related to but are not part of the scope of the impact statement which is the subject of the meeting.

(6) Identify other environmental review and consultation requirements so the lead and cooperating agencies may comply with section 1502.25.

(7) Indicate the relationship between the timing of the preparation of environmental analyses and the agency's tentative planning and the decision-making schedule.

(8) When practicable hold an early scoping meeting or meetings which may be integrated with any other early planning meeting the agency has. Such scoping meeting will often be appropriate when the impacts of a particular action are confined to specific sites.

(b) As part of the scoping process the lead agency may:

(1) Set page limits on environmental documents (§ 150.27).

(2) Set time limits (§ 1501.8).

(c) An agency shall revise the determinations made under paragraphs (a) and (b) of this section if substantial changes are made later in the proposed action or if significant new circumstances (including information) arise which bear on the proposal or its impacts.

§ 1501.8 TIME LIMITS

Although the Council has decided that universal time limits for the entire NEPA process are too inflexible to prescribe, Federal agencies are encouraged to set time limits appropriate to individual action (consistent with § 1506.10). When multiple agencies are involved the reference to agency below means lead agency.

(a) The agency shall:

(1) Consider the following factors in determining time limits:

(i) Potential for environmental harm.

(ii) Size of the proposed action.

(iii) State of the art of analytic techniques.

(iv) Degree of public need for the proposed actions, including the consequences of delay.

(v) Number of persons and agencies affected.

(vi) Degree to which relevant information is known and if not known the time required for obtaining it.

(vii) Degree to which the action is controversial.

(2) Set limits if an applicant for the proposed action requests them, provided that they are consistent with the purposes of NEPA and other essential considerations of national policy.

(b) The agency may:

(1) Set overall time limits or limits for each constituent part of the NEPA process, which may include:

(i) Decision on whether to prepare an environmental impact statement (if not already decided).

(ii) Determination of the scope of the environmental impact statement.

(iii) Preparation of the draft environmental impact statement.

(iv) Review of any commnts on the draft environmental impact statement from the public and agencies.

(v) Preparation of the final environmental impact statement.

(vi) Review of any comments on the final environmental impact statement.

(vii) Decision on the action based in part on the environmental impact statement.

(2) Designate a person (such as the project manager or a person in the agency's office with NEPA responsibilities) to expedite the NEPA process.

(c) State or local agencies or members of the public may request a Federal Agency to set time limits.

PART 1502—ENVIRONMENTAL IMPACT STATEMENTS

Sec.

1502.1 Purpose
1502.2 Implementation
1502.3 Statutory Requirements for Statements
1502.4 Major Federal Actions Requiring the Preparation of Environmental Impact Statements
1502.5 Timing
1502.6 Interdisciplinary Preparation
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1502.16 Affected Environment
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1502.19 Circulation of the Environmental Impact Statement
1502.20 Tiering
1502.21 Incorporation by Reference
1502.22 Incomplete or Unavailable Information
1502.23 Cost-Benefit Analysis
1502.24 Methodology and Scientific Accuracy
1502.25 Environmental Review and Consultation Requirements

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1502.1 PURPOSE

The primary purpose of an environmental impact statement is as an action-forcing device to insure that the policies and goals defined in the Act are infused into the ongoing programs and actions of the Federal Government. It shall provide full and fair discussion of significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment. Agencies shall focus on significant environmental issues and alternatives and shall reduce paperwork and the accumulation of extraneous background data. Statements shall be concise, clear, and to the point, and shall be supported by evidence that the agency has made the necessary environmental analyses. An environmental impact statement is more than a disclosure document. It shall be used by Federal officials in conjunction with other relevant material to plan actions and make decisions.

§ 1502.2 IMPLEMENTATION

To achieve the purposes set forth in § 1502.1 agencies shall prepare environmental impact statements in the following manner.

(a) Environmental impact statements shall be analytic rather than encyclopedic.

(b) Impacts shall be discussed in proportion to their significance. There shall be only brief discussion of other than significant issues. As in a finding of no significant impact, there should be only enough discussion to show why more study is not warranted.

(c) Environmental impact statements shall be kept concise and shall be no longer than absolutely necessary to comply with NEPA, and with these regulations. Length should vary first with potential environmental problems and then with project size.

(d) Environmental impact statements shall state how alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of the Act and other environmental laws and policies.

(e) The range of alternatives discussed in environmental impact statements shall encompass those the ultimate agency decisionmaker considers.

(f) Agencies shall not commit resources prejudicing selection of alternatives before making a final decision (§ 1506.1).

(g) Environmental impact statements shall serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made.

§ 1502.3 STATUTORY REQUIREMENTS FOR STATEMENTS

As required by sec. 102(2)(C) of NEPA environmental impact statements (§ 1508.11) are to be included in every recommendation or report
On proposals (§ 1508.22)
For legislation and (§ 1508.16)
Other major Federal actions (§ 1508.17)
Significantly (§ 1508.25)
Affecting (§§ 1508.3, 1508.8)
The quality of the human environment (§ 1508.14).

§ 1502.4 MAJOR FEDERAL ACTIONS REQUIRING THE PREPARATION OF ENVIRONMENTAL IMPACT STATEMENTS

(a) Agencies shall make sure the proposal which is the subject of an environmental impact statement is properly defined. Agencies shall use the criteria for scope (§ 1508.24) to determine which proposal(s) shall be the subject of a particular statement. Proposals or parts of proposals which are related to each other closely enough to be, in effect, a single course of action shall be evaluated in a single impact statement.

(b) Environmental impact statements may be prepared, and are sometimes required, for broad Federal actions such as the adoption of new agency programs or regulations (§ 1508.17). Agencies shall prepare statements on broad actions to be relevant to policy and timed to coincide with meaningful points in agency planning and decisiomaking.

(c) When preparing statements on broad actions, agencies may find it useful to evaluate the proposal(s) by one or more agencies in one of the following ways:

(1) Geographic, including actions occurring in the same general location, such as an ocean, region, or metropolitan area.

(2) Generic, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter.

(3) Technological development including federal or federally assisted research, development or demonstration programs aimed at developing new technologies which, if applied, could significantly affect the quality of the human environment. Statements shall be prepared on such programs and shall be available before the program has reached a stage of investment or commitment to implementation likely to determine subsequent development or restrict later alternatives.

(d) Agencies shall as appropriate employ scoping (§ 1501.7), tiering (§ 1502.20), and other methods listed in §§ 1500.4 and 1500.5 to relate broad and narrow actions and to avoid duplication and delay.

§ 1502.5 TIMING

An agency shall commence preparation of an environmental impact statement as close as possible to the time the agency makes or is presented with a proposal (§ 1508.22) so that preparation can be completed in time for the final statement to be included in any recommendation or report on the proposal. The statement shall be prepared early enough so that it can practically serve as an important contribution to the decisionmaking process and shall not be used to rationalize or justify decisions already made (§§ 1500.2(c), 1501.2, and 1502.2). For instance:

(a) For projects directly undertaken by Federal agencies such statements shall be prepared at the feasibility analysis (go-no go) stage and may be supplemented at a later stage if necessary.

(b) For applications to the agency appropriate preliminary environmental assessments or statements shall be commenced at the latest immediately after the application is received, but federal agencies are encouraged to

prepare them earlier, preferably jointly with applicable State or local agencies.

(c) For adjudication, the final environmental impact statement shall normally precede the final staff recommendation and that portion of the public hearing related to the impact study. In appropriate circumstances the statement may follow preliminary hearings designed to gather information for use in the statements.

§ 1502.6 INTERDISCIPLINARY PREPARATION

Environmental impact statements shall be prepared using an interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts section (102(2)(A) of the Act). The disciplines of the preparers shall be correlated to the scope and issues identified in the scoping process (§ 1501.7).

§ 1502.7 PAGE LIMITS

The text of final environmental impact statements (e.g., paragraphs (d) through (g) of § 1502.10) shall normally be less than 150 pages and for proposals of unusual scope or complexity shall normally be less than 300 pages.

§ 1502.8 WRITING

Environmental impact statements shall be written in plain language and may use appropriate graphics so that they may be understood by decisionmakers and the public. Agencies should employ writers of clear prose or editors to write, review, or edit statements, which will be based upon the analysis and supporting data from the natural and social sciences and the environmental design arts.

§ 1502.9 DRAFT, FINAL, AND SUPPLEMENTAL STATEMENTS

Except as provided in § 1506.8 environmental impact statements shall be prepared in two stages and may be supplemented.

(a) Draft environmental impact statements shall be prepared in accordance with the scope decided upon in the scoping process. The lead agency shall work with the cooperating agencies and shall obtain comments as required in Part 1503. At the time the draft statement is prepared it must fulfill and satisfy to the fullest extent possible the requirements established for final statements in section 102(2)(C) of the Act. If a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion. In the draft statement the agency shall make every effort to disclose and discuss at appropriate points in the text all major points of view on the environmental impacts of the alternatives including the proposed action.

(b) Final environmental impact statements shall respond to comments as required in Part 1503. In the final statement the agency shall discuss at appropriate points in the text the existence of any responsible opposing view not adequately discussed in the draft statement and shall indicate the agency's response to the issues raised.

(c) Agencies:

(1) Shall prepare supplements to either draft or final environmental impact statements if:

(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or

(ii) There are significant new circumstances, relevant to environmental concerns (including information), bearing on the proposed action or its impacts.

(2) May also prepare supplements when the agency determines that the purposes of the Act will be furthered by doing so.

(3) Shall adopt procedures for introducing a supplement into its formal administrative record, if such a record exists.

(4) Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft statement unless alternative procedures are approved by the Council.

§ 1502.10 RECOMMENDED FORMAT

Agencies shall use a format for environmental impact statements which will encourage good analysis and clear presentation of the alternatives including the proposed actions. The following standard format for environmental impact statements should be followed unless there is a compelling reason to do otherwise:

(a) Cover sheet

(b) Summary

(c) Table of Contents

(d) Purpose of and Need for Action

(e) Alternatives Including Proposed Action (secs. 102(2)(C)(iii) and 102(2)(E) of the Act)

(f) Environmental Consequences (especially secs. 102(2)(C)(i), (ii), (iv), and (v) of the Act

(g) Affected Environment

(h) List of Preparers

(i) List of Agencies, Organizations, and Persons to Whom Copies of the Statement Are Sent

(j) Index

(k) Appendices (if any).

If a different format is used, it shall include paragraphs (a), (b), (c), (h), (i), and (j), of this section and shall include the substance of paragraphs (d), (e), (f), (g), and (k) of this section as further described in §§ 1502.11-1502.18 in any appropriate format.

§ 1502.11 COVER SHEET

The cover sheet shall not exceed one page. It shall include:

(a) The name of the responsible agencies including the lead agency and any cooperating agencies.

(b) The name of the proposed action that is the subject of the statement (and if appropriate the names of related cooperating agency actions), together with the State(s) and county(ies) (or the country if applicable) where the action is located.

(c) The name, address, and telephone number of the person at the agency who can supply further information.

(d) A designation of the statement as a draft, final, or draft or final supplement.

(e) A one paragraph abstract of the statement.

(f) The date by which comments must be received (computed in cooperation with EPA (§ 1506.10)).

§ 1502.12 SUMMARY

Each environmental impact statement shall contain a summary which adequately and accurately summarizes the statement. The summary shall stress the major conclusions, areas of controversy (including issues raised by agencies and the public), and the issues to be resolved (including the choice among alternatives). The summary will normally not exceed 15 pages.

§ 1502.13 PURPOSE AND NEED

The statement shall briefly specify the underlying purpose and need to which the agency is responding in proposing the action and the alternatives. Normally this section shall not exceed one page.

§ 1502.14 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Environmental Consequences (§ 1502.15) and the Affected Environment (§ 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharpening the issues and providing a clear basis for choice among options by the decisionmaker and the public. In this section agencies shall:

(a) Rigorously explore and objectively evaluate all reasonable alternatives, and for alternatives which were eliminated from detailed study, briefly discuss the reasons for such elimination.

(b) Devote substantial treatment to each alternative considered in detail including the proposed action so that reviewers may evaluate the comparative merits.

(c) Include reasonable alternatives not within the jurisdiction of the lead agency.

(d) Include the no action alternative.

(e) Identify the environmentally preferable alternative (or alternatives if two or more are equally preferable) and the reasons for identifying it. If the alternative identified is for no action, the agency shall also identify the alternative other than no action that is environmentally preferable and the reasons for identifying it.

(f) Identify the agency's preferred alternative or alternatives if one or more exists in the draft statement and identify such alternative(s) in the final statement unless another law prohibits the expression of such a preference.

(g) Include appropriate mitigation measures not already included in the proposed action or alternatives.

§ 1502.15 ENVIRONMENTAL CONSEQUENCES

This section forms the scientific and analytic basis for the comparisons under § 1502.14. It shall consolidate the discussions of those elements required by secs. 102(2)(C) (i), (ii), (iv), and (v) of NEPA which are within the scope of the statement and as much of sec. 102(2)(C)(iii) as is necessary to support the comparisons. This includes the environmental impacts of the proposed action and alternatives, any adverse environmental effects which cannot be avoided should the proposal be implemented, the relationship between short-term uses of man's environment and the maintenance and enhancement of long-term productivity, and any irreversible or irretrievable commitments of resources which would be involved in the proposed action should it be implemented. The Council intends that preparers not cause duplication in the discussions under § 1502.14 and this section. This section shall include discussions of:

(a) Direct effects and their significance (§ 1508.8).

(b) Indirect effects and their significance (§ 1508.8).

(c) Possible conflicts between the proposed action and the objectives of Federal, regional, State, and local land use plans, policies, and controls for the area concerned.

(d) The environmental effects of alternatives including the proposed action. The comparisons under § 1502.14 will be based on this discussion.

(e) Energy requirements and conservation potential of various alternatives and mitigation measures.

(f) Natural or depletable resource requirements and conservation potential of various alternatives and mitigation measures.

(g) Means to mitigate adverse environmental impacts (if not fully covered under § 1502.14(g)).

§ 1502.16 AFFECTED ENVIRONMENT

The environmental impact statement shall succinctly describe the environment of the area or areas to be affected by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in a statement shall be commensurate with the importance of the impact, with less important material summarized, consolidated, or simply referenced. Agencies shall avoid useless bulk in statements and shall concentrate effort and attention on important issues. Verbose descriptions of the affected environment are themselves no measure of the adequacy of an environmental impact statement.

§ 1502.17 LIST OF PREPARERS

The environmental impact statement shall list the names, together with their qualifications and professional disciplines (§§ 1502.6 and 1502.8), of the persons who were primarily responsible for preparing the environmental impact statement or significant background papers, including basic components of the statement. Where possible the names of persons who are responsible for a particular analysis, including analyses in background papers, shall be identified. Normally the list will not exceed two pages.

§ 1502.18 APPENDIX

If an agency prepares an appendix to an environmental impact statement the appendix shall:

(a) Consist of material prepared in connection with an environmental impact statement (as distinct from material which is not so prepared and which is incorporated by reference (§ 1502.21)).

(b) Normally consist of material which substantiates any analysis fundamental to the impact statement.

(c) Normally be analytic and relevant to the decision to be made.

(d) Be circulated with the environmental impact statement or be readily available on request.

§ 1502.19 CIRCULATION OF THE ENVIRONMENTAL IMPACT STATEMENT

Agencies shall circulate the entire draft and final environmental impact statements except as provided in § 1502.18(d) and 1503.4(c). However, if the statement is unusually long, the agency may circulate the summary instead, except that the entire statement shall be furnished to:

(a) Any Federal agency which has jurisdiction by law or special expertise with respect to any environmental impact involved and any appropriate Federal, State or local agency authorized to develop and enforce environmental standards.

(b) Any person, organization, or agency requesting the entire environmental impact statement.

(c) In the case of a final environmental impact statement any person, organization, or agency which submitted substantive comments on the draft.

If the agency circulates the summary and thereafter receives a timely request for the entire statement, the time for comment for that requestor only shall be extended by at least 15 days beyond the minimum period.

§ 1502.20 TIERING

Agencies are encouraged to tier their environmental impact statements to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review (§ 1508.26). Whenever a broad environmental impact statement has been prepared (such as a program or policy statement) and a subsequent statement or environmental assessment is then prepared on an action included within the

entire program or policy (such as a site specific action) the subsequent statement or environmental assessment need only summarize the issues discussed in the broader statement and incorporate such discussions by reference and shall concentrate on the issues specific to the subsequent action. Tiering may also be appropriate for different stages of actions. (Section 1508.26).

§ 1502.21 INCORPORATION BY REFERENCE

Agencies shall incorporate material into an environmental impact statement by reference when to do so will cut down on bulk without impeding agency and public review of the action. The incorporated material shall be cited in the statement and its content briefly described. No material may be incorporated by reference unless it is reasonably available for inspection by potentially interested persons within the time allowed for comment. Material based on proprietary data which is itself not available for review and comment shall not be incorporated by reference.

§ 1502.22 INCOMPLETE OR UNAVAILABLE INFORMATION

Agencies dealing with gaps in relevant information including scientific uncertainty, shall always make clear that such information is lacking or that uncertainty exists.

(a) If the information is essential to a reasoned choice among alternatives and is not known and the costs of obtaining it are not exorbitant, the agency shall include the information in the environmental impact statement.

(b) If the information is important to the decision and the means to obtain it are not known (e.g., the means for obtaining it are beyond the state of the art) the agency shall weigh the need for the action against the risk and severity of possible adverse impacts were the action to proceed in the face of uncertainty. If the agency proceeds, it shall include a worst case analysis.

§ 1502.23 COST-BENEFIT ANALYSIS

If a cost-benefit analysis is being considered for the proposed action, it shall be incorporated by reference or appended to the statement as an aid in evaluating the environmental consequences. To assess the adequacy of compliance with sec. 102(2)(B) of the Act the statement shall when a cost-benefit analysis is prepared discuss the relationship between that analysis and any analyses of unquantified environmental impacts, values, and amenities.

§ 1502.24 METHODOLOGY AND SCIENTIFIC ACCURACY

Agencies shall insure the professional, including scientific, integrity of the discussions and analyses in environmental impact statements. They shall identify any methodologies used and shall make explicit reference by footnote to the scientific and other sources relied upon for conclusions in the statement.

§ 1502.25 ENVIRONMENTAL REVIEW AND CONSULTATION REQUIREMENTS

To the fullest extent possible, agencies shall prepare draft environmental impact statements concurrently with and integrated with environmental impact analyses and related surveys and studies required by the Fish and Wildlife Coordination Act (16 U.S.C. Sec. 661 et seq.) the National Historic Preservation Act of 1966 (16 U.S.C. Sec. 470 et seq.), the Endangered Species Act of 1972 (16 U.S.C. Sec. 1531 et seq.) and other environmental review laws.

PART 1503—COMMENTING

Sec.
1503.1 Inviting Comments
1503.2 Duty to Comment
1503.3 Specificity of Comments
1503.4 Response to Comments

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amenedd (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1503.1 INVITING COMMENTS

(a) After preparing a draft environmental impact statement and before preparing a final environmental impact statement the agency shall:

(1) Obtain the comments of any Fedral agency which has jurisdiction by law or special expertise with respect to any environmental impact involved or which is authorized to develop and enforce environmental standards.

(2) Request the comments of appropriate State and local agencies which are authorized to develop and enforce environmental standards, or any agency which has requested that it receive statements on actions of the kind proposed.

(3) Request comments from the public, affirmatively soliciting comments from those persons or organizations who may be interested or affected.

(b) After preparing a final environmental impact statement an agency may request comments on it before the decision is finally made. In any case other agencies or persons may make comments before the final decision unless a different time is provided under § 1506.10.

§ 1503.2 DUTY TO COMMENT

Federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved or which are authorized to develop and enforce environmental standards shall comment on statements within their jurisdiction, expertise, or authority. A Federal agency may (and a cooperating agency that is satisfied that its views are adequately reflected in the environmental impact statement would) reply that it has no comment.

§ 1503.3 SPECIFICITY OF COMMENTS

Comments on an environmental impact statement or on a proposed action shall be as specific as possible and may address either the adequacy of the statement or the merits of the alternatives discussed or both. When a commenting agency criticizes a lead agency's predictive methodology, the commenting agency should describe the alternative methodology which it prefers and why.

§ 1503.4 RESPONSE TO COMMENTS

(a) An agency preparing a final environmental impact statement shall assess and consider comments both individually and collectively, and shall respond by one or more of the means listed below specifying its response in the final statement. Possible responses are to:

(1) Modify the proposed action.

(2) Develop and evaluate alternatives not previously given serious consideration by the agency.

(3) Supplement, improve, or modify its analyses.

(4) Make factual corrections.

(5) Explain why the comments do not warrant further agency response,

citing the sources, authorities, or reasons which support the agency's position and, if appropriate, indicate those circumstances which would trigger agency reappraisal or further response.

(b) All substantive comments received on the draft statement (or summaries thereof where the response has been exceptionally voluminous), should be attached to the final statement whether or not the comment is thought to merit individual discussion by the agency in the text of the statement.

(c) If changes are minor and are confined to the responses described in paragraphs (a)(4) and (5) of this section, agencies may write them on errata sheets and attach them to the statement instead of rewriting the draft statement. In such cases only the comments, the responses, and the changes and not the final statement need be circulated (§ 1502.19). The entire document with a new cover sheet shall be filed as the final statement (§ 1506.9).

PART 1504—PREDECISION REFERRALS TO THE COUNCIL OF PROPOSED FEDERAL ACTIONS FOUND TO BE ENVIRONMENTALLY UNSATISFACTORY

Sec.
1504.1 Purpose
1504.2 Criteria for Referral
1504.3 Procedure for Referrals and Response

AUTHORITY: NEPA, the Environmenal Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1504.1 PURPOSE

(a) This part establishes procedures for referring to the Council Federal interagency disagreements concerning proposed major Federal actions that might cause unsatisfactory environmental effects. It provides means for early resolution of such disagreements.

(b) Under section 309 of the Clean Air Act (42 U.S.C. 7609), the Administrator of the Environmental Protection Agency is directed to review and comment publicly on the environmental impacts of Federal activities, including actions for which environmental impact statements are prepared. If after this review the Administrator determines that the matter is "unsatisfactory from the standpoint of public health or welfare or environmental quality," section 309 directs that the matter be referred to the Council (hereafter "environmental referrals").

(c) Under section 102(2)(C) of the Act other Federal agencies may make similar reviews of environmental impact statements, including judgments on the acceptability of anticipated environmental impacts. These reviews must be made available to the President, the Council and the public.

§ 1504.2 CRITERIA FOR REFERRAL

Environmental referrals should only be made to the Council after concerted, timely (as early as possible in the process), but unsuccessful attempts to resolve differences with the lead agency. In determining what environmental objections to the matter are appropriate to refer to the Council, an agency should weigh potential adverse environmental impacts, considering:

(a) Possible violation of national environmental standards or policies
(b) Severity
(c) Geographical scope

(d) Duration
(e) Importance as precedents
(f) Availability of environmentally preferable alternatives.

§ 1504.3 PROCEDURE FOR REFERRALS AND RESPONSE

(a) A Federal agency making the referral to the Council shall:

(1) Advise the lead agency at the earliest possible time that it intends to refer a matter to the Council unless a satisfactory agreement is reached.

(2) Include such advice in the referring agency's comments on the draft environmental impact statement, except when the statement does not contain adequate information to permit an assessment of the matter's environmental acceptability.

(3) Identify any essential information that is lacking and request that it be made available at the earliest possible time.

(4) Send copies of such advice to the Council.

(b) The referring agency shall deliver its referral to the Council not later than twenty-five (25) days after the final environmental impact statement has been made available to the Environmental Protection Agency, commenting agencies, and the public. Except when an extension of this period has been granted by the lead agency, the council will not accept a referral after that date.

(c) The referral shall consist of:

(1) A copy of the letter signed by the head of the referring agency and delivered to the lead agency informing the lead agency of the referral and the reasons for it, and requesting that no action be taken to implement the matter until the Council acts upon the referral. The letter shall include a copy of the statement referred to in § 1504.3(c)(2) below.

(2) A statement supported by factual evidence leading to the conclusion that the matter is unsatisfactory from the standpoint of public health or welfare or environmental quality. The statement shall:

(i) Identify any material facts in controversy and incorporate (by reference if appropriate) agreed upon facts,

(ii) Identify any existing environmental requirements or policies which would be violated by the matter.

(iii) Present the reasons the referring agency believes the matter is environmentally unsatisfactory.

(iv) Contain a finding by the agency whether the issue raised is one of national importance because of the threat to national environmental resources or policies or for some other reason.

(v) Review the steps taken by the referring agency to bring its concerns to the attention of the lead agency at the earliest possible time, and

(vi) Give the referring agency's recommendations as to what mitigation alternative, further study, or other course of action (including abandonment of the matter) are necessary to remedy the situation.

(d) Not later than twenty-five (25) days after the referral to the Council, the lead agency may deliver a response to the Council and the referring agency. If the lead agency requests more time and gives assurance that the matter will not go forward in the interim, the Council may grant an extension. The response shall:

(1) Address fully the issues raised in the referral.

(2) Be supported by evidence.

(3) Give the lead agency's response to the referring agency's recommendations.

(e) Not later than twenty-five (25) days after receipt of both the referral and any response or upon being informed that there will be no response (unless the lead agency agrees to a longer time), the Council may take one or more of the following actions:

(1) Conclude that the process of referral and response has successfully resolved the problem.

(2) Initiate discussions with the agencies with the objective of mediation with referring and lead agencies.

(3) Hold public meetings or hearings to obtain additional views and information.

(4) Determine that the issue is not one of national importance and request the referring and lead agencies to pursue their decision process.

(5) Determine that the issue should be further negotiated by the referring and lead agencies and is not appropriate for Council consideration until one or more heads of agencies report to the Council that the agencies' disagreements are irreconcilable.

(6) Publish its findings and recommendations (including where appropriate a finding that the submitted evidence does not support the position of an agency).

(7) When appropriate, submit the referral and the response together with the Council's recommendation to the President for action.

PART 1505—NEPA AND AGENCY DECISIONMAKING

Sec.

1505.1 Agency decisionmaking procedures
1505.2 Record of decision in those cases requiring environmental impact statements
1505.3 Implementing the decision

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970 as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1505.1 AGENCY DECISIONMAKING PROCEDURES

Agencies shall adopt procedures (§ 1507.3) to ensure that decisions are made in accordance with the policies and purposes of the Act. Such procedures shall include but not be limited to:

(a) Implementing procedures under section 102(2) to achieve the requirements of sections 101 and 102(1).

(b) Designating the major decision points for the agency's principal programs likely to have a significant effect on the human environment and assuring that the NEPA process corresponds with them.

(c) Requiring that relevant environmental documents, comments, and responses be part of the record in formal rulemaking or adjudicatory proceedings.

(d) Requiring that relevant environmental documents, comments, and responses accompany the proposal through the existing agency review process so that agency officials use the statement in making decisions.

(e) Requiring that the alternatives considered by the decisionmaker are encompassed by the range of alternatives discussed in the relevant environmental documents and that the decisionmaker consider the alternatives described in the environmental impact statement. If another decision document accompanies the relevant environmental documents to the decisionmaker, agencies are encouraged to make available to the public before the decision is made any part of that document that relates to the comparison of alternatives.

§ 1505.2 RECORD OF DECISION IN THOSE CASES REQUIRING ENVIRONMENTAL IMPACT STATEMENTS

At the same time of its decision (or, if appropriate, its recommendation to Congress) each agency shall prepare a concise public record of decision. The record, which may be integrated into any other record prepared by the

agency, including that required by OMB Circular A–95, part I, sections 6 (c) and (d), and part II, section 5(b)(4), shall state:

(a) What the decision was.

(b) If an alternative other than those designated pursuant to § 1502.14 (e) has been selected, the reasons why other specific considerations of national policy overrode those alternatives.

(c) Whether all practicable means to avoid or minimize environmental harm have been adopted, and if not, why they were not. For any mitigation adopted, a monitoring and enforcement program where applicable shall be adopted and summarized.

§ 1505.3 IMPLEMENTING THE DECISION

Agencies may provide for monitoring to assure that their decisions are carried out and should do so in important cases. Mitigation (§ 1505.2(c)) and other conditions established in or during the review of the environmental impact statement and committed as part of the decision shall be implemented by the appropriate agency. The lead agency shall:

(a) Include appropriate conditions in grants, permits or other approvals.

(b) Condition funding of actions on mitigation.

(c) Upon request, inform cooperating or commenting agencies on progress in carrying out mitigation measures proposed by any such agency and adopted by the agency making the decision.

(d) Upon request, make available to the public the results of relevant monitoring.

PART 1506—OTHER REQUIREMENTS OF NEPA

Sec.

1506.1 Limitations on actions during NEPA process
1506.2 Elimination of duplication with State and local procedures
1506.3 Adoption
1506.4 Combining documents
1506.5 Agency responsibility
1506.6 Public involvement
1506.7 Further guidance
1506.8 Proposals for legislation
1506.9 Filing requirements
1506.10 Timing of agency action
1506.11 Emergencies
1506.12 Effective date

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1506.1 LIMITATIONS ON ACTIONS DURING NEPA PROCESS

(a) Until an agency issues a record of decision as provided in § 1505.2 (except as provided in subsection (c)), no action concerning the proposal shall be taken which would:

(1) Have an adverse environmental impact; or

(2) Limit the choice of reasonable alternatives.

(b) If any agency is considering an application from a non-Federal entity, and is aware that the applicant is planning to take an action within the agency's jurisdiction that would meet either of the criteria in § 1506.1(a), then the agency shall promptly notify the applicant that the agency will take appropriate action to insure that the objectives and procedures of NEPA are achieved.

(c) While work on a required program environmental impact statement is in progress and the action is not covered by an existing program statement, agencies shall not undertake in the interim any major Federal action which may significantly affect the quality of the human environment and which is covered by the program unless such action:

(1) Is justified independently of the program;

(2) Will not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives; and

(3) Is itself accompanied by an adequate environmental impact statement.

§ 1506.2 ELIMINATION OF DUPLICATION WITH STATE AND LOCAL PROCEDURES

(a) Agencies authorized by law to cooperate with State agencies of statewide jurisdiction pursuant to section 102(2)(D) of the Act may do so.

(b) Agencies shall cooperate with State and local agencies to the fullest extent possible to reduce duplication in NEPA and comparable State and local requirements, unless they are specifically barred from doing so by some other law. Except where an agency is proceeding in the manner specified by paragraph (a) of this section, such cooperation shall to the fullest extent possible include:

(1) Joint planning processes.

(2) Joint environmental research and studies.

(3) Joint public hearings (except where otherwise provided by statute).

(4) Joint environmental assessments and joint environmental impact statements. In such cases one or more Federal agencies and one or more State or local agencies shall be joint lead agencies. Where State laws or local ordinances have environmental impact statement requirements in addition to but not in conflict with those in NEPA, Federal agencies shall cooperate in fulfilling the requirements of those as well as Federal laws so that one document will comply with all applicable laws.

(c) To better integrate environmental impact statements into state or local planning processes, statements shall discuss any inconsistency of a proposed action with any approved State or local plan and laws (whether or not federally sanctioned).

§ 1506.3 ADOPTION

(a) An agency may adopt a Federal draft or final environmental impact statement or portion thereof provided that the agency treats the statement as a draft and recirculates it (except as provided below in paragraph (b) of this section): *And provided,* That the statement or portions thereof meets the standards for an adequate draft statement under these regulations.

(b) A cooperating agency may adopt without recirculating the environmental impact statement of a lead agency when, after an independent review of the statement, the cooperating agency concludes that its comments and suggestions have been satisfied.

(c) When an agency adopts a statement which is not final within the agency that prepared it, or when the action it assesses is the subject of a referral under part 1504, or when the statement's adequacy is the subject of a judicial action which is not final, the agency shall so specify.

§ 1506.4 COMBINING DOCUMENTS

Any environmental document in compliance with NEPA may be combined with any other agency document to reduce duplication and paperwork.

§ 1506.5 AGENCY RESPONSIBILITY

(a) If an agency relies on an applicant to submit initial environmental

information, the agency should assist the applicant by outlining the types of information required. In all cases, the agency should make its own evaluation of the environmental issues and take responsibility for the scope and content of environmental assessments.

(b) Except as provided in §§ 1506.2 and 1506.3 any environmental impact statement prepared pursuant to the requirements of NEPA shall be prepared directly by or under contract to the lead agency or where appropriate under § 1501.6(b), a cooperating agency. In the case of such contract it is the intent of these regulations that the contractor be chosen solely by the lead agency or by the lead agency in cooperation with cooperating agencies or where appropriate by a cooperating agency to avoid any conflict of interest. Contractors shall execute a disclosure statement prepared by the lead agency or where appropriate the cooperating agency specifying that they have no financial or other interest in the outcome of the project. If the document is prepared by contract, the responsible Federal official shall furnish guidance and participate in the preparation and shall independently evaluate the statement prior to its approval. Nothing in this section is intended to prohibit any agency from requesting any person to submit information to it or any person from submitting information to any agency.

§ 1506.6 PUBLIC INVOLVEMENT

Agencies shall: (a) Make diligent effort to involve the public in preparing and implementing their NEPA procedures.

(b) Provide public notice of NEPA-related hearings, meetings, and the availability of environmental documents by means calculated to inform those persons and agencies who may be interested or affected.

(1) In all cases the agency shall mail notice to those who have requested it on an individual action.

(2) In the case of an action with effects of national concern such notice shall include publication in the *Federal Register* and notice by mail to national organizations with interest in the matter and may include listing in the 102 Monitor.

(3) In the case of an action with effects primarily of local concern the notice may include:

(i) Notice to State and local agencies pursuant to OMB Circular A–95.

(ii) Following the affected State's public notice procedures for comparable actions.

(iii) Publication in local newspapers (in papers of general circulation rather than legal papers).

(iv) Notice through other local media.

(v) Notice to potentially interested community organizations including small business associations.

(vi) Publication in newsletters that may be expected to reach potentially interested persons.

(vii) Direct mailing to owners and occupants of nearby or affected property.

(viii) Posting of notice on and off site in the area where the action is to be located.

(c) Hold or sponsor public hearings or public meetings whenever appropriate. Criteria shall include whether there is.

(1) Substantial environmental controversy concerning the proposed action or substantial interest in holding the hearing.

(2) A request for a hearing by another agency with jurisdiction over the action supported by reasons why a hearing will be helpful.

(d) Solicit appropriate information from the public.

(e) Explain in its procedures where interested persons can get information or status reports on environmental impact statements and other elements of the NEPA process.

(f) Make environmental impact statements, the comments received, and any underlying documents available to the public pursuant to the provisions of the Freedom of Information Act (5 U.S.C. 552), without regard to the exclusion of intra- or interagency memoranda where such memoranda transmit comments of Federal agencies on the environmental impact of the proposed action.

§ 1506.7 FURTHER GUIDANCE

The Council may provide further guidance concerning NEPA and its procedures including:

(a) A handbook which the Council may supplement from time to time which shall in plain language provide guidance and instructions concerning the application of NEPA and these regulations.

(b) Publication of the Council's Memoranda to Heads of Agencies.

(c) In conjunction with the Environmental Protection Agency and the publication of the 102 Monitor, notice of:

(1) Research activities;

(2) Meetings and conferences related to NEPA; and

(3) Successful and innovative procedures used by agencies to implement NEPA.

§ 1506.8 PROPOSALS FOR LEGISLATION

The NEPA process for proposals for legislation (§ 1508.16) significantly affecting the quality of the human environment shall be integrated with the legislative process of the Congress. A legislative environmental impact statement is the detailed statement required by law which shall accompany proposed legislation to the Congress. Preparation of a legislative environmental impact statement shall include consultation with appropriate agencies (which may be pursuant to OMB Circular A–19) and conform with the requirements of these regulations except as follows:

(a) There need not be a scoping process.

(b) The legislative statement shall otherwise be treated in the same manner as a draft statement except as further specified. There need not be a final environmental impact statement: *Provided,* That when any of the following conditions exist, both the draft and final environmental impact statements on the legislative proposal shall be prepared and circulated as provided by sections 1503.1 and 1506.10.

(1) A Congressional Committee with jurisdiction over the proposal has a rule requiring both draft and final environmental impact statements.

(2) The proposal results from a study process required by statute (such as those required by the Wild and Scenic Rivers Act (16 U.S.C. 1271 et seq.) and the Wilderness Act (16 U.S.C. 1131 et seq.)).

(3) Legislative approval is sought for Federal or federally assisted construction or other projects which the agency recommends be located at specific geographic locations. For proposals requiring an environmental impact statement for the acquisition of space by the General Services Administration, a draft statement shall accompany the Prospectus or the 11(b) Report of Building or the 11(b) Report of Building Project Surveys to the Congress, and a final statement shall be completed before site acquisition.

(4) The agency decides to prepare draft and final statements.

(c) Comments on the legislative statement shall be given to the lead agency which shall forward them along with its own responses to the Congressional committees with jurisdiction.

(d) The Environmental Protection Agency may reduce the period for review required by § 1506.10 to insure that comments and responses are received by the appropriate Congressional committee prior to hearings on the proposal.

§ 1506.9 FILING REQUIREMENTS

Environmental impact statements together with comments and responses shall be filed with the Environmental Protection Agency, attention Office of Federal Activities (A–104), 401 M Street SW., Washington, D.C. 20460. Statements shall be filed with EPA no earlier than they are also transmitted to commenting agencies and the public. EPA shall deliver one copy of each statement to the Council, which shall satisfy the requirement of availability to the President.

§ 1506.10 TIMING OF AGENCY ACTION

(a) No decision on the proposed action shall be made or recorded under § 1505.2 by a Federal agency until the later of the following dates:

(1) Ninety (90) days after publication of the notice described in paragraph (d) of this section for a draft environmental impact statement.

(2) Thirty (30) days after publication of the notice described in paragraph (d) of this section for a final environmental impact statement.

Provided, That when an agency has formally established an internal appeal process, through which agencies or the public may take appeals and make their views known after preparation of the final environmental impact statement, and which provides a real opportunity to alter the decision, an administratively reviewable decision in the proposed action may be made after publication of the notice described in paragraph (d) of this section for a final environmental impact statement. This means that the period for appeal and the period prescribed by paragraph (a)(2) of this section may run concurrently. In such a case the environmental impact statement shall explain the timing and the public's right of appeal.

Provided further, That when an agency's primary purpose is the protection of public health and safety, the agency may, with the approval of the Council, adopt procedures under § 1507.3 providing for a finding to be published in the *Federal Register* that it is necessary to waive the time requirement specified in paragraph (a)(2) of this section to preserve public health and safety.

Provided further, That when an agency's primary purpose is the protection of public health and safety and when that agency publishes proposed rules in the *Federal Register* for a period of public review prescribed by a statute the agency administers, that time period and the period prescribed under paragraph (a)(2) of this section may run concurrently.

(b) If the final environmental impact statement is filed within ninety (90) days after a draft environmental impact statement is filed with the Environmental Protection Agency, the minimum thirty (30) day period and the minimum ninety (90) day period may run concurrently.

(c) Subject to paragraph (e) of this section agencies shall allow not less than 45 days for comments on draft statements.

(d) The Environmental Protection Agency shall publish a notice in the *Federal Register* each week of the environmental impact statements filed with the Environmental Protection Agency the preceding week. The date of publication of this notice shall be the date from which the minimum time periods of this section shall be calculated.

(e) The lead agency may extend prescribed periods. The Environmental Protection Agency may upon a showing by the lead agency of compelling reasons of national policy reduce the prescribed periods and may upon a showing by any other Federal agency of compelling reasons of national policy also extend prescribed periods, but only after consultation with the lead agency. (Also see § 1507.3(d).) If the lead agency does not concur, the matter shall be referred to CEQ for resolution. When the Environmental Protection Agency reduces or extends any period of time it shall notify the Council.

§ 1506.11 EMERGENCIES

Where emergency circumstances make is necessary to take an action with significant environmental impact without observing the provisions of these regulations, the Federal agency proposing to take the action should consult with the Council about alternative arrangements. Agencies and the Council will limit such waivers to actions necessary to control the immediate impacts of the emergency. Other actions remain subject to NEPA review.

§ 1506.12 EFFECTIVE DATE

Th effective date of these regulations is eight months after their final publication in the *Federal Register*.

(a) These regulations shall apply to the fullest extent practicable to ongoing activities and environmental documents begun before the effective date. These regulations do not apply to an environmental impact statement if the draft statement was filed before the effective date of these regulations. No completed environmental documents need be redone by reason of these regulations. Until these regulations are applicable, the Council's guidelines published in the *Federal Register* of August 1, 1973, shall continue to be applicable. In cases where these regulations are applicable the guidelines are superseded. However, nothing shall prevent an agency from proceeding under these regulations at an earlier time.

(b) NEPA shall continue to be applicable to actions begun before January 1, 1970, to the fullest extent possible.

PART 1507—AGENCY COMPLIANCE

Sec.
1507.1 Compliance
1507.2 Agency Capability to Comply
1507.3 Agency Procedures

AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enhancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1507.1 COMPLIANCE

All agencies of the Federal Government shall comply with these regulations. It is the intent of these regulations to allow each agency flexibility in adapting its implementing procedures authorized by § 1507.3 to the requirements of other applicable laws.

§ 1507.2 AGENCY CAPABILITY TO COMPLY

Each agency shall be capable (in terms of personnel and other resources) of complying with the requirements enumerated below. Such compliance may include use of other's resources, but the using agency shall itself have sufficient capability, at minimum, to evaluate what others do for it. Agencies shall:

(a) Fulfill the requirements of Sec. 102(2)(A) of the Act to utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may have an impact on the human environment, Agencies shall designate a person to be responsible for overall review of agency NEPA compliance.

(b) Identify methods and procedures required by Sec. 102(2)(B) to insure that presently unquantified environmental amenities and values may be given appropriate consideration.

(c) Prepare adequate environmental impact statements pursuant to Sec. 102(2)(c) and comment on statements in the areas where the agency has jurisdiction by law or special expertise or is authorized to develop and enforce environmental standards.

(d) Study, develop, and describe alternatives to recommended courses of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. This requirement of Sec. 102(2)(E) extends to all such proposals, not just the more limited scope of Sec. 102(2)(C)(iii) where the discussion of alternatives is confined to impact statements.

(e) Comply with the requirements of Sec. 102(2)(H) that the agency initiate and utilize ecological information in the planning and development of resource-oriented projects.

(f) Fulfill the requirements of sections 102(2)(F), 102(2)(G), and 102(2)(I), of the Act and of Executive Order 11514, Protection and Enhancement of Environmental Quality, Sec. 2.

§ 1507.3 AGENCY PROCEDURES

(a) Not later than eight months after publication of these regulations as finally adopted in the *Federal Register,* or five months after the establishment of an agency, whichever shall come later, each agency shall as necessary adopt procedures to supplement these regulations. When the agency is a department major subunits are encouraged (with the consent of the department) to adopt their own procedures. Such procedures shall not paraphrase these regulations. They shall confine themselves to implementing procedures. Each agency shall consult with the Council while developing its procedures and before publishing them in the *Federal Register* for comment. The procedures shall be adopted only after an opportunity for public review and after review by the Council for conformity with the Act and these regulations. The Council shall complete its review within 30 days. Once in effect they shall be filed with the Council and made readily available to the public. Agencies are encouraged to publish explanatory guidance for these regulations and their own procedures. Agencies shall continue to review their policies and procedures and to revise them as necessary to ensure full compliance with the purposes and provisions of the Act.

(b) Agency procedures shall comply with these regulations except where compliance would be inconsistent with statutory requirements and shall include:

(1) Those procedures required by §§ 1501.2(d), 1502.9(c)(3), 1503.1(c), 1505.1, 1506.6(e) and 1508.4.

(2) Specific criteria for and identification of those typical classes of action:

(i) Which normally do require environmental impact statements.

(ii) Which normally do not require either an environmental impact statement or an environmental assessment (categorical exclusions (§ 1508.4)).

(iii) Which normally require environmental assessments but not necessarily environmental impact statements.

(c) Agency procedures may include specific criteria for providing limited exceptions to the provisions of these regulations for proposed actions that are specifically authorized under criteria established by an Executive Order or statute to be kept secret in the interest of national defense or foreign policy and are in fact properly classified pursuant to such Executive Order or statute. Environmental assessments and environmental impact statements which address classified proposals may be safeguarded and restricted from public dissemination in accordance with agencies' own regulations applicable to classified information. These documents may be organized so that classified portions can be included as annexes, in order that the unclassified portions can be made available to the public.

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(d) Agency procedures may provide for periods of time other than those presented in § 1506.10 when necessary to comply with other specific statutory requirements.

PART 1508—TERMINOLOGY AND INDEX

Sec.

1508.1 Terminology
1508.2 Act
1508.3 Affecting
1508.4 Categorical Exclusion
1508.5 Cooperating Agency
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1508.21 Notice of Intent
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AUTHORITY: NEPA, the Environmental Quality Improvement Act of 1970, as amended (42 U.S.C. 4371 et seq.), Section 309 of the Clean Air Act, as amended (42 U.S.C. 1857h–7), and Executive Order 11514, Protection and Enchancement of Environmental Quality (March 5, 1970, as amended by Executive Order 11991, May 24, 1977).

§ 1508.1 TERMINOLOGY

The terminology of this part shall be uniform throughout the Federal Government.

§ 1508.2 ACT

"Act" means the National Environmental Policy Act, as amended (42 U.S.C. 4321, et seq.) which is also referred to as "NEPA."

§ 1508.3 AFFECTING

"Affecting" means will or may have an effect on.

§ 1508.4 CATEGORICAL EXCLUSION

"Categorical Exclusion" means a category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a Federal agency in implementation of these regulations (§ 1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact is needed. Any such procedures shall provide for extraordinary cir-

cumstances in which a normally excluded action may have a significant environmental effect.

§ 1508.5 COOPERATING AGENCY

"Cooperating Agency" means any Federal agency other than a lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment. The selection and responsibilities of a cooperating agency are described in § 1501.6. A State or local agency of similar qualifications or, when the effects are on a reservation, an Indian Tribe may by agreement with lead agency become a cooperating agency.

§ 1508.6 COUNCIL

"Council" means the Council on Environmental Quality established by Title II of the Act.

§ 1508.7 CUMULATIVE IMPACT

"Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

§ 1508.8 EFFECTS

"Effects" include:

(a) Direct effects, which are caused by the action and occur at the same time and place.

(b) Indirect effects, which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Effects and impacts as used in these regulations are synonymous. Effects includes ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), economic, social, or health, whether direct, indirect, or cumulative. Effects may also include those resulting from actions which may have both beneficial and detrimental effects, even if on balance the agency believes that the effect will be beneficial.

§ 1508.9 ENVIRONMENTAL ASSESSMENT

"Environmental Assessment":

(a) Means a public document for which a Federal agency is responsible that serves to:

(1) Briefly provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact.

(2) Aid an agency's compliance with the Act when no environmental impact statement is necessary.

(3) Facilitate preparation of such a statement when one is necessary.

(b) Shall include brief discussions of the need for the proposal, of alternatives as required by sec. 102(2)(E), of the environmental impacts of the proposed action and alternatives, and a listing of agencies and persons consulted. Most environmental assessments do not exceed several pages in length.

§ 1508.10 ENVIRONMENTAL DOCUMENT

"Environmental Document" includes the documents specified in §§ 1508.9, 1508.11, 1508.13 and 1508.21.

§ 1508.11 ENVIRONMENTAL IMPACT STATEMENT

"Environmental Impact Statement" means a detailed written statement as required by Sec. 102(2)(C) of the Act.

§ 1508.12 FEDERAL AGENCY

"Federal agency" means all agencies of the Federal Government. It does not mean the Congress, the Judiciary, or the President, including the performance of staff functions for the President in his Executive Office.

§ 1508.13 FINDING OF NO SIGNIFICANT IMPACT

"Finding of No Significant Impact" means a document by a Federal agency briefly presenting the reasons why an action, not otherwise excluded (§ 1508.4), will not have a significant effect on the human environment and for which an environmental impact statement therefore will not be prepared. It shall include the environmental assessment or a summary of it and shall note any other environmental documents related to it (§ 1501.7(a)(5)).

§ 1508.14 HUMAN ENVIRONMENT

"Human Environment" shall be interpreted comprehensively to include the natural and physical environment and the interaction of people with that environment. (See the definition of "effects" (§ 1508.8).) This means that exclusively economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment.

§ 1508.15 LEAD AGENCY

"Lead Agency" means the agency or agencies which have prepared or have taken primary responsibility to prepare the environmental impact statement.

§ 1508.16 LEGISLATION

"Legislation" includes a bill or legislative proposal to Congress developed by or with the significant cooperation and support of a Federal agency, but does not include requests for appropriations.[1] The test for significant cooperation is whether the proposal is in fact predominantly that of the agency rather than another source. Drafting does not by itself constitute significant cooperation. Proposals for legislation include requests for ratification of treaties. Only the agency which has primary responsibility for the subject matter involved will prepare a legislative environmental impact statement.

§ 1508.17 MAJOR FEDERAL ACTION

"Major Federal action" includes actions with effects that may be major and which are potentially subject to Federal control and responsibility. Major reinforces but does not have a meaning independent of significantly (§ 1508.25), Actions include the circumstance where the responsible officials

[1] The Council in consultation with OMB had been prepared to propose this wording and § 1508.12 for comment. Thereafter *Sierra Club* v. *Andrus* (D.C. Cir. No. 75–1871, May 15, 1978) was decided. We would appreciate comment on the implications of that case for these provisions.

fail to act and that failure to act is reviewable by courts or administrative tribunals under the Administrative Procedure Act or other applicable law as agency action. If a Federal program is delegated or otherwise transferred to State or local government, unless Congress intended otherwise, the Federal agency shall continue to be responsible for compliance with the Act and shall insure the preparation of environmental impact statements if they would be required but for the delegation or transfer. If the Federal agency may legally require the State or local agency to follow an environmental impact statement process, as a condition of the delegation or transfer, it shall do so. If not, the Federal agency shall prepare the statements (except as provided in § 1506.5).

(a) Actions include new and continuing activities, including projects and programs entirely or partly financed, assisted, conducted, regulated, or approved by federal agencies; new or revised agency rules, regulations, plans, policies, or procedures; and legislative proposals (§§ 1506.8, 1508.16). Actions do not include funding assistance solely in the form of general revenue sharing funds, distributed under the State and Local Fiscal Assistance Act of 1972, 31 U.S.C. 1221 et seq., with no Federal agency control over the subsequent use of such funds. Actions do not include bringing civil or criminal enforcement actions.

(b) Federal actions tend to fall within one of the following categories:

(1) Adoption of official policy, such as rules, regulations, and interpretations adopted pursuant to the Administrative Procedure Act, 5 U.S.C. 551 et seq.; treaties and international conventions or agreements; formal documents establishing an agency's policies which will result in or substantially alter agency programs.

(2) Adoption of formal plans, such as official documents prepared or approved by federal agencies which guide or prescribe alternative uses of federal resources, upon which future agency actions will be based.

(3) Adoption of programs, such as a group of concerted actions to implement a specific policy or plan; systematic and connected agency decisions allocating agency resources to implement a specific statutory program or executive directive.

(4) Approval of specific projects, such as construction or management activities located in a defined geographic area. Projects include actions approved by permit or other regulatory decision as well as federal and federally assisted activities.

§ 1508.18 Matter

"Matter" includes for purposes of Part 1504:

(a) With respect to the Environmental Protection Agency, any proposed legislation, project, action or regulation as those terms are used in Section 309(a) of the Clean Air Act (42 U.S.C. 7609).

(b) With respect to all other agencies, any proposed major federal action to which Section 102(2)(C) of NEPA applies.

§ 1508.19 MITIGATION

"Mitigation" includes:

(a) Avoiding the impact altogether by not taking a certain action or parts of an action.

(b) Minimizing impacts by limiting the degree or magnitude of the action and its implementation.

(c) Rectifying the impact by repairing, rehabilitating, or restoring the impacted environment.

(d) Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action.

(e) Compensating for the impact by replacing or providing substitute resources or environments.

§ 1508.20 NEPA PROCESS

"NEPA process" means all measures necessary for compliance with the requirements of Section 2 and Title I of NEPA.

§ 1508.21 NOTICE OF INTENT

"Notice of Intent" means a notice that an environmental impact statement will be prepared and considered. The notice shall briefly:

(a) Describe the proposed action and possible alternatives.

(b) Describe the agency's proposed scoping process including whether, when, and where any scoping meeting will be held.

(c) State the name and address of a person within the agency who can answer questions about the proposed action and the environmental impact statement.

§ 1508.22 PROPOSAL

"Proposal" refers to that stage in the development of an action when an agency subject to the Act has a goal and is actively considering one or more alternative means of accomplishing that goal and the effects can be meaningfully evaluated. Preparation of an environmental impact statement on a proposal should be timed (§ 1502.5) so that the final statement may be completed in time for the statement to be included in any recommendation or report on the proposal. A proposal may exist in fact as well as by agency declaration that one exists.

§ 1508.23 REFERRING AGENCY

"Referring agency" means the federal agency which has referred any matter to the Council after a determination that the matter is unsatisfactory from the standpoint of public health or welfare or environmental quality.

§ 1508.24 SCOPE

Scope consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement. The scope of an individual statement may depend on its relationships to other statements (§§ 1502.20 and 1508.26). In scoping environmental impact statements agencies shall consider 3 types of actions, 3 types of alternatives, and 3 types of impacts. They include:

(a) Actions (other than unconnected single actions) which may be:

(1) Connected actions, which means that they are closely related and therefore should be discussed in the same impact statement. Actions are connected if they:

(i) Automatically trigger other actions which may require environmental impact statements.

(ii) Cannot or will not proceed unless other actions are taken previously or simultaneously.

(iii) Are interdependent parts of a larger action and depend on the larger action for their justification.

(2) Cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact statement.

(3) Similar actions, which when viewed with other reasonably foreseeable or proposed agency actions, have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography. An agency may wish to analyze these actions in the same impact statement. It should do so when the best way to assess adequately the combined impacts of similar actions or reasonable alternatives to such actions is to treat them in a single impact statement.

(b) Alternatives, which include: (1) No action alternative. (2) Other

reasonable courses of actions. (3) Mitigation measures (not in the proposed action).

(c) Impacts, which may be: (1) Direct. (2) Indirect. (3) Cumulative.

§ 1508.25 SIGNIFICANTLY

"Significantly" as used in NEPA requires considerations of both context and intensity:

(a) *Context.* This means that the significance of an action must be analyzed in several contexts such as society as a whole (global, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

(b) *Intensity.* This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

(1) Impacts that may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial.

(2) The degree to which the proposed action affects public health or safety.

(3) Unique characteristics of the geographic area such as proximity to historic sites, park lands, prime farm lands, wetlands, wild and scenic rivers, or ecologically critical areas.

(4) The degree to which the effects on the quality of the human environment are likely to be highly controversial.

(5) The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

(6) The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

(7) Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

(8) Whether the action may have a significant adverse effect on an area or site listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.

(9) Whether the action may have a significant adverse effect on the habitat or an endangered, or threatened species that has been determined to be critical under the Endangered Species Act of 1973.

(10) Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.

§ 1508.26 TIERING

"Tiering" refers to the coverage of general matters in broader environmental impact statements (such as national program or policy statements) with subsequent narrower statements or environmental analyses (such as regional or basinwide program statements or ultimately site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared. Tiering is appropriate when the sequence of statements or analyses is:

(a) From a program, plan, or policy environmental impact statement to a program, plan, or policy statement or analysis of lesser scope or to a site-specific statement or analysis.

(b) From an environmental impact statement on a specific action at an early stage (such as need and site selection) to a supplement (which is preferred) or a subsequent statement or analysis at a later stage (such as design detail and environmental mitigation). Tiering in such cases is appropriate when it helps the lead agency to focus on the issues which are ripe for decision and exclude from consideration issues already decided or not yet ripe.

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APPENDIX E

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